THE

# ELECTRICAL REVIEW.

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## ELECTRICAL REVIEW.

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THE

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## METROPOLITAN ELECTRIC TRAMWAYS.

THE inauguration of the newly electrified section of tramways between Wood Green and North London, on Friday last, marks the beginning of a new era in the transit facilities of the vast district concerned. This region is no less densely populated than the area in the West of London which is served by the London United Tramways, and, being nearer to the business parts of the City and County, it is even more in favour as a residential quarter for those whose occupations lie in the central districts. Moreover, the suburban tramways of the Metropolitan Co. make connection at several points with the already existing horse tramways of the L.C.C., which are leased to the North Metropolitan Tramways Co., in which the former company holds a controlling interest; the latter tramways comprise nearly 50 miles of route, and are about to be converted to electrical traction—they would have been converted long ago, but for the obstructive policy of the London County Council, which has delayed the introduction of electricity as a motive power on the London tramway systems by at least five years. The Metropolitan system, it will be seen, by the existence of this intramural network of tramways, possesses an immense advantage, as compared with the London United Co., whose traffic depends largely upon the various underground railways running to the West-end. Further, the extensive systems of the Middlesex and Herts County Councils, which comprise a length of nearly 40 miles of route, and are to be leased to the company, will prove of the utmost importance to their undertaking. The company also practically owns the whole undertaking of the North Metropolitan Electric Power Supply Co., whose three power stations, at Brimsdown, Willesden, and Hertford, are already running, and, by virtue of their large and varied loads, and the efficient character of the plant installed, power to drive the cars will be available at the lowest possible rates. Thus it will be seen that the new undertaking opens with the brightest prospects, and we confidently anticipate for it a successful career.

Difficulties, it is true, have not been wanting, so far as regards the associated companies; the fanatical struggles of the local authorities of Edmonton, Tottenham, Enfield, &c., to establish a parochial electrical supply undertaking, in defiance of the wishes of their ratepayers, will be fresh in our readers' memories, but happily these have been for the most part overcome, and the ratepayers are to be congratulated thereon. A cloud also still hangs over the North Metropolitan Tramways, seeing that the L.C.C., to conciliate the borough councils, still requires one-third of the tramways to be equipped on the conduit system. We should have thought that the experience gained on the south side of the river would have convinced the Council of the folly of perpetuating and aggravating its error in this respect; but the fact is

that, after its elaborate demonstrations to the borough councils of the abounding merits of the conduit system, the L.C.C. finds it impossible to convince them that the trolley system is really the better. To mix the two systems, as is proposed, is almost as foolish as to adopt the conduit throughout; the duplicate equipment of cars to run on both systems, and the delays apparently inseparable from the conduit system, are serious drawbacks. Still, we must be content with what we can get, and the fact that the Council evidently realises its error, of which it had abundant warning in the technical Press, is something to be thankful for. It would be too much to expect it to acknowledge its fault.

---

Wireless Telegraphy.

THE practical application of wireless telegraphy as a means of transmitting intelligible messages has rendered it necessary for his Majesty's Government to bring the system under special legislative control. The following is the explanatory memorandum which was prefixed to the short Bill introduced by Lord Stanley on July 18th:—

**The object of this Bill is to give the Government control over wireless telegraphy, in order to preclude its improper use in time of war or in any other national emergency, and to regulate the working of different stations in such a manner as to secure the greatest efficiency of communication between all stations. In this view the Bill proposes that the establishment of wireless telegraph stations, whether on shore or on British ships, without a licence, shall be illegal, and authorises the Postmaster-General (with the consent of the Admiralty, War Office, and Board of Trade) to grant licences for such stations, and to prescribe the conditions under which they may be worked.**

It might be thought that the measure which is intended to effect the above objects confers upon the Government a monopoly in the use of wireless telegraphy. This monopoly, however, was conferred by the original telegraph Acts. This appears to have been decided in the case of the Attorney-General *v.* The Edison Telephone Co., of London (6 Q.B.D. 244). In that case the question whether the telephone was a telegraph within the meaning of the Acts was before the Court for consideration. A company leased these telephones to subscribers at yearly rents which produced a profit to the company, and arranged the wires so that subscribers could converse with one another when put into communication by a servant of the company. The Court held that the telephone was a "telegraph" within the meaning of the Telegraph Acts, 1863 and 1869, and also that a conversation through the telephone was a "message," or at all events "a communication transmitted by a telegraph," and therefore a "telegram" within the meaning of those Acts, and that since the company made a profit out of the rents, conversations held by subscribers through their telephones were infringements of the exclusive privilege of transmitting telegrams granted to the Postmaster-General by this Act, and were not within the exceptions mentioned in paragraph 5. The judgement of Mr. Justice Stephen contained the following passage:—

**Indeed, though for scientific purposes it may no doubt be necessary to distinguish between telegraphs and telephones, it seems to us that the word "telegraph," as defined in the Telegraph Acts, is wide enough to cover every instrument which may ever be invented which employs electricity transmitted by a wire as a means for conveying information. Indeed, looking to the extension of the definition inserted in the Act of 1869, the words "transmitted by a wire" might probably be left out of this definition.**

His Lordship also said:—

**Putting these enactments together, and substituting the definitions given for the words defined, the material part of Section 4 of the Act of 1869 will stand thus: "The Postmaster-General shall have the exclusive privilege of transmitting messages or other communications transmitted, or intended for transmission, by any wire or wires used for the purpose of telegraphic communication, with any casing, coating, tube, or pipe enclosing the same, and any apparatus connected therewith for the purpose of telegraphic communication, or by any apparatus (other than such wire) for transmitting messages or other communications by means of electric signals."** In simpler language, the Postmaster-General **is to have the exclusive privilege of transmitting messages or other communications by any wire and apparatus connected therewith used for telegraphic communication, or by any other apparatus for transmitting messages or other communications by means of electric signals. The result of the definition seems to be that any apparatus for transmitting messages by electric signals is a telegraph, whether a wire is used or not, and that any apparatus, of which a wire used for telegraphic communication is an essential part, is a telegraph, whether the communication is made by electricity or not. It would include, on the one hand, electric signals made, if such a thing were possible, from place to place, through the earth or the air, and on the other, a set of common bells, worked by wires pulled by the hand, if they were so arranged as to constitute a code of signals.**

Nevertheless, the Bill under notice goes further than the Telegraph Act, in that it enables the Courts to control the use of wireless telegraphy on British ships in any part of the world.

Clause 1 (1) provides that:—

**A person shall not establish any wireless telegraph station, or install or work any apparatus for wireless telegraphy, in any place or on board any British ship except under and in accordance with a licence granted in that behalf by the Postmaster-General with the consent of the Admiralty, the Army Council, and the Board of Trade.**

By Clause 1 (2) the Postmaster-General is to issue licenses upon such terms as he may determine. By Clause 1 (3), any person who keeps a station without a licence becomes exposed to very serious penalties. Other paragraphs of this clause specify the procedure by which the Act may be enforced.

Clause 2 is of considerable importance to those who desire to prosecute research. It provides that

**Where the applicant for a licence proves to the satisfaction of the Postmaster-General that the sole object of obtaining the licence is to enable him to conduct experiments in wireless telegraphy, a licence for that purpose shall be granted, subject to such special terms, conditions, and restrictions as the Postmaster-General may think proper.**

The Act is to extend

**To the whole of the British Islands, and to all British ships, whilst on the high seas or in the territorial waters abutting on the coast of the British Islands, and the Royal Courts of the Channel Islands shall register this Act accordingly.**

---

Municipal Trading *v.* Industrial Freedom.

THE recent meeting of the Industrial Freedom League brings into prominence once more the question of municipal trading, and its effects upon the national industries. As Lord Avebury pointed out, the local indebtedness of the country bids fair, at the present rate of increase, to eclipse the National Debt. One of the most extraordinary features of the subject is the confusion of ideas as regards "debt" and "capital" which reigns in the minds of the advocates of municipal trading. For example, our estimable contemporary, the *Municipal Journal*, commenting upon Lord Avebury's speech, complains that he regards the money spent by a municipal authority as so much "debt." If a company had spent the same sum for a similar purpose, he would call it "capital." Quite so! When one invests one's own money in an undertaking, of course it is capital. But when one pledges one's credit, and invests someone else's money in one's own business, what can that be but debt? Our contemporary goes on to say that the municipal authority is *repaying* the money every year, and in time every penny will be returned "to the persons from whom it was borrowed." To say that an individual or corporation which has borrowed money is not in debt to that extent is a contradiction in terms. Apparently municipal finance has a language of its own, as indeed it has a peculiar system of accountancy, unknown in any other commercial circle.

## THE COLLIERY EXHIBITION.

(*Continued from page* 124.)

*Pumps and Haulage Gear.* — There are no special difficulties attaching to the driving of pumps for colliery purposes by electric motors, and this is a class of work which has made considerable headway. The important element is to see that the pumps are mechanically strong, and a good engineering job, and that all the gear is readily accessible and the glands easily packed. Hitherto, for large heads, the ram pump has been almost exclusively used, but there are now many instances of centrifugal pumps being used for high lifts. Among those exhibiting centrifugals were Gwynnes, Ltd., who showed a 6-in. "Invincible" pressure pump for lifting 1,000 gallons per minute, against a head of 600 ft. These high lifts are accomplished by connecting several pumps in series, the discharge of one joining the inlet of the next, and the pumps being mounted on the same spindle. Special charging methods are sometimes necessary, and for this purpose the Gwynne Co. have several alternative arrangements, one being a type of steam ejector where steam is available, another a small vacuum pump mounted direct on the centrifugal, and driven from the pump shaft. In these cases the foot valve, which is generally the part to give trouble, may be dispensed with. A centrifugal pump being a high-speed machine, lends itself particularly well to direct driving by an electric motor. For pumping out sumps and pockets a portable type of motor-driven centrifugal makes a very convenien arrangement, and the illustration (fig. 14) shows a portable Gwynne pump, connected up to a three-phase Bergmann motor, and mounted on a four-wheeled trolley.

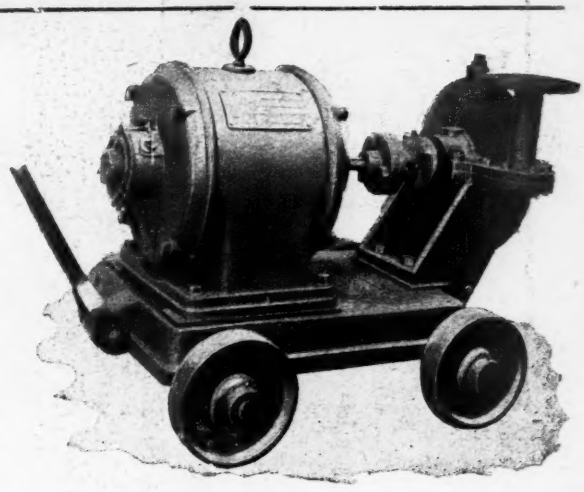


Fig. 14.

Among other interesting exhibits at this stand was a 5-in. "Invincible" centrifugal pump specially designed for coal washing. It is fitted with Gwynne-Sergeant patent tubular disks, and is capable of pumping up solids up to 2½ in. cube. The impeller is lined with renewable chilled sides.

A three-stage centrifugal pump for high lifts was also shown by the Worthington Co., and was coupled up direct to a Westinghouse three-phase motor.

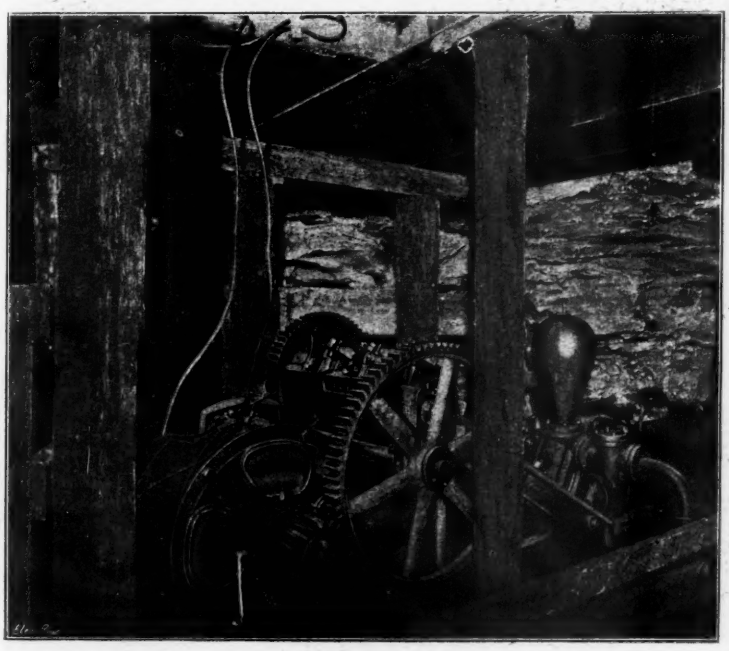


Fig 15.

The available space in mines is, necessarily, limited, and for this reason it is necessary to compress the plant into the smallest space possible. The illustration (fig. 15) shows a very compact arrangement of geared pump and motor exhibited by the General Electric Co. It is here shown fitted up in a mine. In order to shorten up the plant as much as possible, the pump is fixed at an angle of about 45°, thus considerably reducing the overall length. The pump and motor, together with the gearing, are mounted on steel joists, which are carried on wheels, the whole being sufficiently portable to be moved from place to place. The pump is of the three-throw type, of substantial construction, and the gears are all machine-cut. Two hauling gears are also shown by this firm, one of the main and tail portable type, the other a single drum portable hauling gear. In general construction these are similar to the single drum hauling gear shown in fig. 16. In this case the pinion on the motor-shaft is of raw hide to ensure noiseless running, and it may be here mentioned that raw-hide pinions are now used for considerable powers—say, up to 50 h.p. and more. The pinion gears into a machine-cut steel spur-wheel and mounted on a countershaft, gearing into a double helical wheel on the drum shaft. The teeth of the helical gear are machine moulded, although for very heavy sets

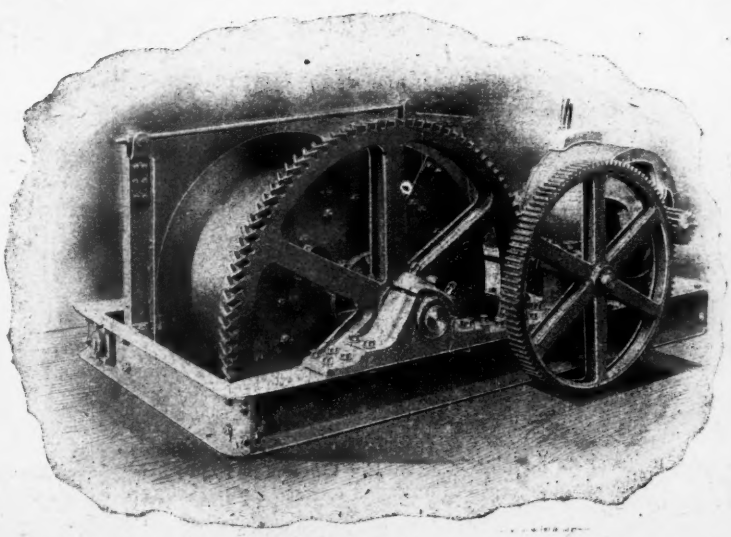


Fig. 16.

low-speed motors are used, gearing direct into cut-steel gearing on the drum shaft. The whole combination is mounted on a stiff bedplate made up of steel joists rigidly

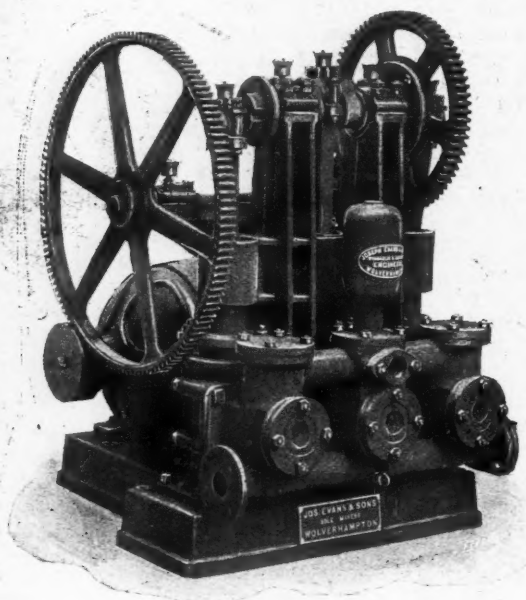



Fig. 17.

bolted together. The main bearings both in the haulage gear and the pump combinations are set at an angle, so that the pressure does not take place against the cap of the bearing, nor against the joint between the top and bottom brasses, and the sets are designed on sound engineering lines throughout.

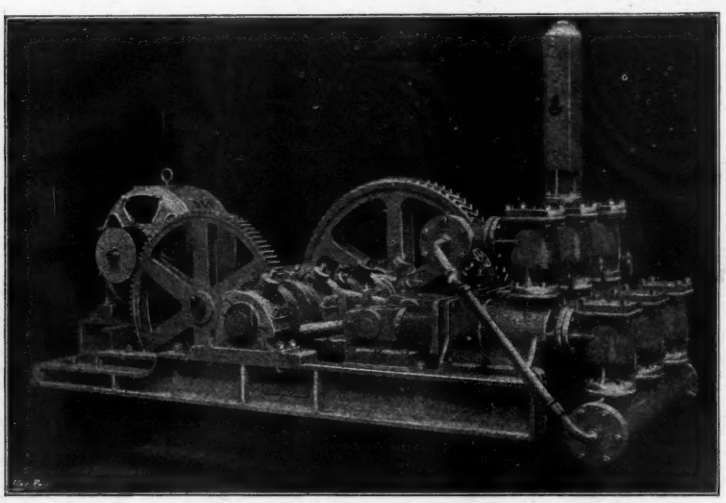


Fig. 18.

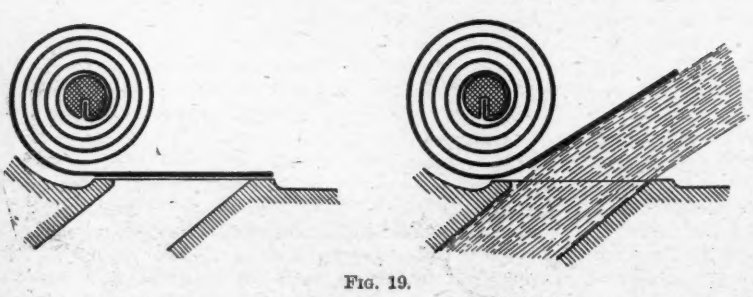


Fig. 19.

The General Electric Co. had also a very complete exhibit of electrical apparatus, including three-phase steam generator, main three-phase switchboard, motors, switches and other accessories of the company's well-known types.

A stand devoted exclusively to pumps was that of Messrs. Joseph Evans & Sons, of Wolverhampton, who showed no fewer than 13 pumps of various types and sizes. Among these was a 7 in. × 12 in. × 6½ in. × 12 in. compound

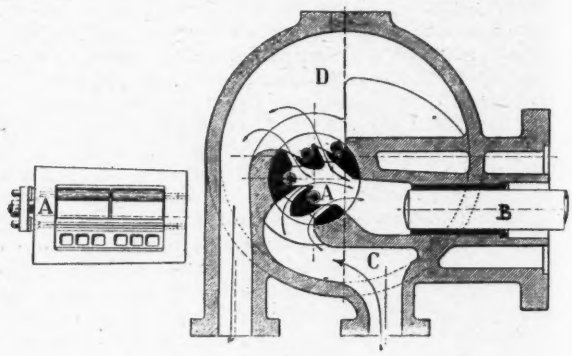



Fig. 20.

"beam" pump suitable for high-pressure boiler feeding up to 200 lbs. steam pressure. In this type of pump the crank motion and fly-wheel are dispensed with, the steam cylinders being mounted on a strong frame directly above the rams, and the high and low-pressure piston-rods being connected together by a beam. This permits of a much lower speed than is possible with a crank motion, the makers claiming that this type of pump can be run from the maximum speed down to one stroke per minute.

A motor-driven three-throw pump was also shown, and is here illustrated in fig. 17. This pump is suitable either for boiler feeding or pumping water up to heads of 350 ft. The gears are machine-cut, the ratio of reduction between the motor and the countershaft being five to one. This pump is shown fitted with rubber disk valves working on gun-metal seats, but for pumping hot water, gun-metal valves are used. It will be seen from the illustration that the valve boxes are so constructed as to give ready access to the valves, and the frame work is of very strong design. The bearings are all bushed with gun-metal.

Fig. 18 shows a horizontal type of Evans treble-ram pump suitable for heads of 600 ft., geared direct to an electric motor. In this case also all bearings are of gun-metal, including the connecting rod heads. The general construction of this set will be obvious from the illustration.

A pump attracting considerable attention was the "Express" pump exhibited by Messrs. Fraser and Chalmers. This pump had a capacity of 200 gallons per minute when working against a total head of 175 ft., and running at 200 r.p.m. This high speed permits of direct gearing by single reduction gear to an electric motor, the pump in question being geared up to a motor of 15 H.P. Such high speeds are made possible by the use of "Gutermuth" valves, for which Messrs. Fraser and Chalmers are licensees. As is well known, the ordinary type of mushroom valve restricts the flow of water considerably when under much pressure. With the "Gutermuth" valve the water passes through the port, practically without deflection or deviation. This is well illustrated, in fig. 19, which

also shows very clearly the construction of the valve. This consists merely of a gun-metal strip of from about $\frac{1}{32}$ in. to $\frac{1}{16}$ in. thick, wound up spirally in the form of a clock spring. The inside end is fixed to a spindle, which is secured in a valve casing, and the other end forms a flap normally covering the valve port. The valves are always fitted so as to cover the port opening at an angle. The action of the valve will be rendered clear by our illustration, fig. 20, which shows a section through a valve box. The part marked A represents a valve-cone containing four sets of valves, the bottom pair being suction valves communicating with the inlet chamber C, and the other two being delivery valves opening into the air-vessel D and the discharge outlet; B represents the pump ram, which is connected up by a cross-head in the usual way to the crankshaft. These valves may be used either for hydraulic work, or for air compressors up to pressures of 3,000 lbs. per sq. in. The force required to lift the valve is very small. According to the makers, a valve of four coils, 4 in. wide, 3 in. long, and $\frac{1}{32}$ in. thick, requires only a pressure of 2 lbs. to open to 30°. This works out to about 0·25 lb. per sq. in., whilst the valves would resist a permanent working pressure of 125 lbs. per sq. in. In a well-got-up book issued by the agents, numerous illustrated descriptions of the adaptation of this type of valve to various purposes are given, many of the examples being conversions of existing pumps and compressors, resulting in increased speeds and outputs.

A direct geared three-throw pump was also shown by Messrs. Scott & Mountain. This has rams 4 in. in diameter with 6-in. stroke, the capacity being 50 gallons per minute against a head of 800 ft. For high lifts double gearing is usually adopted by the firm, a spur wheel being provided at each end of the crankshaft, and the whole of the gearing is machine cut. The rams, valves, and seats are all of gun-metal, the glands and stuffing boxes being specially long. Cross-heads are provided with large slippers working in oil wells, so providing continuous lubrication. The bearing surfaces are all of ample dimensions. The general mechanical design is similar to this firm's usual steam engine practice.

(*To be continued.*)

## GLASGOW CORPORATION TELEPHONE ACCOUNTS.

The report of the Telephone Committee of the Glasgow Corporation, together with an abstract of the accounts for the year ending May 31st, 1904, has lately been issued, the accounts having been approved by the Town Council after a debate in which criticism was pointed and free. The report and accounts refer to the third complete year of working of the system, and afford interesting information in a variety of directions. The total capital account now stands at £320,782 12s., exclusive of stores and tools, which represent £11,032 more. The capital added during the year was £50,050, and the number of stations added 2,283. Last year the capital added was £78,556, and the number of stations added was 3,643, so that in the year under review the increase in stations is considerably less than last year, and the relative increase of capital slightly greater. This illustrates the fact that, even with a large amount of spare plant, additional stations mean additional capital expenditure, and that the possession of spare plant does not necessarily mean that the cost of adding new stations decreases, one of the many telephonic delusions indulged in by the Glasgow Town Council. The value of the spare plant was put in the 1903 report at £59,096, and it was described as plant "not yet yielding revenue." The present report states that "the estimated value of the underground, overhead and switchboard plant not yielding revenue is £79,000." By clinging to this formula, the Committee may be deceiving themselves, or may simply intend to put the best face they can on matters; but if they considered last year that the plant which they then described as "not yet yielding revenue" was likely soon to do so, we can well understand the omission this year of the "yet," since there has been an addition of £20,000 to the "estimated" value of the spare plant. Even if the spare plant really represents a value of £79,000, that is equivalent to but 24 per cent. of the total capital account, and for a large and growing telephone system this is a comparatively small proportion of spare plant.

Comparing the total capital account with the statistics of stations, it appears that the £320,782 expended on construction, &c., have provided a total of 11,405 stations of all classes, an average capital cost per station of £28 2s. 6d. Of unlimited rate stations there are 8,385, message rate 352, call offices 235, and party-line 82 (corresponding to about 28 lines), so that the total subscribers' lines equal 9,000, the remaining 2,400 stations comprising inside and outside extension, private line, service, and sundry instruments. Deducting the capital cost of the extension and private line instruments, reckoned at £16,000, the average cost per direct line works out at £33 17s. This is £1 1s. lower than the average capital cost per line according to last year's accounts, a result which points to a modification of the policy of charging working expenses to capital.

The total revenue for the year is stated to be £49,639 1s. 2d., and the total working expenditure is put at £29,119 3s., leaving a balance of £20,519 18s. 2d., of which £16,869 0s. 4d. is absorbed by interest and sinking fund, the remainder, £3,650 17s. 10d. being put to depreciation. Depreciation is thus allowed for at the rate of 1·1 per cent. on the capital invested in the plant. The total depreciation fund accumulated on three years' working amounts to £5,743 7s. 5d. As the depreciation for the present year would amount to over £13,500, if taken at 5 per cent. on the capital invested at the beginning of the year, it is evident that depreciation will soon become a difficulty so serious that it will have to be faced in earnest. It is stated in the report, in the most guarded language possible to frame, that the Committee contemplate a change in the method of operating. This is a sorrowful confession to have to make regarding a telephone system which has been at work for barely three years, and has been proclaimed to be all that there is of most up-to-date and efficient.

That the system is neither up-to-date nor efficient is tolerably well-known; indeed, the recent description of it given before the Glasgow local section of the I.E.E. shows that it consists of a heterogeneous collection of antiquated call-wire and magneto apparatus. The proposal to put the plant on a modern basis, which, we presume, is the intention of the Committee, naturally leads to a consideration of the adequacy of the depreciation fund. The total investment in exchange and subscribers' station plant, which will be affected by a radical reconstruction, is as follows:—

| | | | | | | |
|---|---|---|---|---|---|---|
| Central exchange | ... | ... | ... | £32,982 | 12 | 11 |
| Sub-exchanges... | ... | ... | ... | 9,670 | 1 | 0 |
| Instruments ... | ... | ... | ... | 47,937 | 0 | 10 |
| Public telephones | ... | ... | ... | 2,083 | 14 | 11 |
| Total | ... | ... | ... | £92,673 | 9 | 8 |

Practically all of this plant needs to be replaced if the Glasgow Corporation follow the example of the National Telephone Co. and of the Post Office in adopting modern common battery equipment, such as has been described in the Review at various times during the past few years. The scrap value of the existing obsolete plant would be less than a tenth part of its book value, and the cost of the new equipment throughout would be, for the present system, with adequate spare capacity, about £80,000. An effective reconstruction, to place the system on a similar basis to the Post Office London plant, would therefore cost the Glasgow Corporation, between sacrifice of present investment and new expenditure, about £160,000. This is an aspect of the telephone business which has confronted many telephone companies in the past, and will have to be confronted in turn by the municipalities which have taken up telephony.

In an examination of the accounts of last year (see Electrical Review, October 30th, 1903), we pointed out that there was strong circumstantial evidence leading to the conclusion that a large proportion of the real working expenses was being charged to capital. This conclusion was supported by the fact that, out of a total wage bill of but little less, at the lowest estimate, than £30,000, only £10,310 was charged to working expenses, and the remainder to capital.

It also appeared by the accounts that canvassing expenses were wholly charged to capital. The deduction drawn from a careful analysis of the accounts was that the real loss on the working was merged into the capital account so as to show a profit on paper. This year's accounts support that deduction. The increase in stations has been only 25 per cent., but the increase in working expenses shown, equals nearly 40 per cent. The total amount of salaries and wages charged to working expenses is £14,896 this year as against £10,432 last year, an increase of £4,464, or nearly 43 per cent. As the increase in stations is only 25 per cent., the proportionate increase in labour expense charged to operating and maintenance is nearly double the increase in stations. This shows that the Glasgow Telephone Committee are gradually arriving at a more correct distribution of expenditure, but it is evident that the working expenses are still being favoured at the expense of the capital account. The total staff is now 571, as against 596 last year, a reduction of 25. There has been a reduction of 85 in the outside and engineering departments, and an increase of 60 in the operating and office departments. These changes would leave the total wages bill, allowing for a few increases of pay among the working staff, at about £28,500. The new work done was £50,050, as compared with £78,556 last year, or less than two-thirds. Of this new construction the greater part is contract work, the overhead construction, £9,177, and instruments and public stations, £9,611, being the chief items carried out by the department itself. The wages bill on these, and on supervision and assistance in connection with underground work and exchange construction, would be, at the most, £7,000. At this rate there has been charged to capital about £6,600 of wages and salaries which should have been charged to working expenses. This is better than last year, but the continuance of such a policy, coupled with the neglect of adequate provision for depreciation, makes the whole financial situation of the Glasgow Corporation telephone department most artificial.

A single item will illustrate the extent to which this practice of charging working expenses to capital has been carried. The subscribers' instruments and public stations stand on the books at a total of £50,020. For 11,405 stations this is an average cost of £4 7s. per instrument. The instruments themselves cost £2 10s. each. The cost of wiring and fitting, therefore, stands at £1 17s. per instrument, which is more than double what the average should be. In this one item alone, representing less than a sixth of the total capital, there is about £10,000 which has presumably got there by the process of charging working expenses to capital. In the original estimate the average cost per instrument, fitted up complete with all necessary appurtenances, was put at £3 14s, the price of the instrument itself then being taken at £2 14s. In the case of the exchange apparatus the average book cost per working line is nearly double the estimated cost, although the class of apparatus used is similar to that described in connection with the original estimate. Here, too, the total investment on the books standing at over £42,000, a substantial proportion of the cost may be set down to wages which really belonged to working expenses.

The statistics of stations show that the tendency of the system is to increase in the direction of extension and private line stations. The total direct lines are under 9,000, the remaining 2,400 stations being made up of extension and private line instruments. The increase of the past year, 2,283 instruments, is distributed among the various classes of stations in the proportion of 70 per cent. of direct and party-line stations and 30 per cent. of extension, private line and sundry stations. The number of message rate lines is very small, the total now being but 352, or slightly over 3 per cent. of the total stations. Public stations account for 2 per cent. of the total and unlimited rate lines for 73 per cent., the proportion of unlimited rate lines having fallen from 82 per cent. to 73 per cent. in two years. These figures indicate a great falling off in the rate of increase of direct subscribers' lines.

On the last page of the report a curious table of statistics is published, dealing with the financial results, in which the casual reader is apt to be misled by a misuse of terms. Item 4, termed "gross revenue," is really the total amount payable in advance during the year, *plus* the amount carried forward from the previous year. Item 5, termed "net revenue," is really the gross revenue for the year, being item 4 less the amount carried forward as applicable to next year. By this ingenious device of transforming gross revenue into net revenue several interesting results are obtained. Thus, the "net revenue" per station is given as £4 7s., whereas this is the gross revenue per station, the total expenditure per station being £4 0s. 7d., or 92·66 per cent. of the gross receipts. The percentage of gross revenue to capital expenditure is 15·47 per cent., this being stated in the table as the percentage of "net revenue." A total amount of £4,351, being 8·2 per cent. of the year's revenue, is overdue from subscribers for rentals, tolls and fees.

## METROPOLITAN ELECTRIC TRAMWAYS.

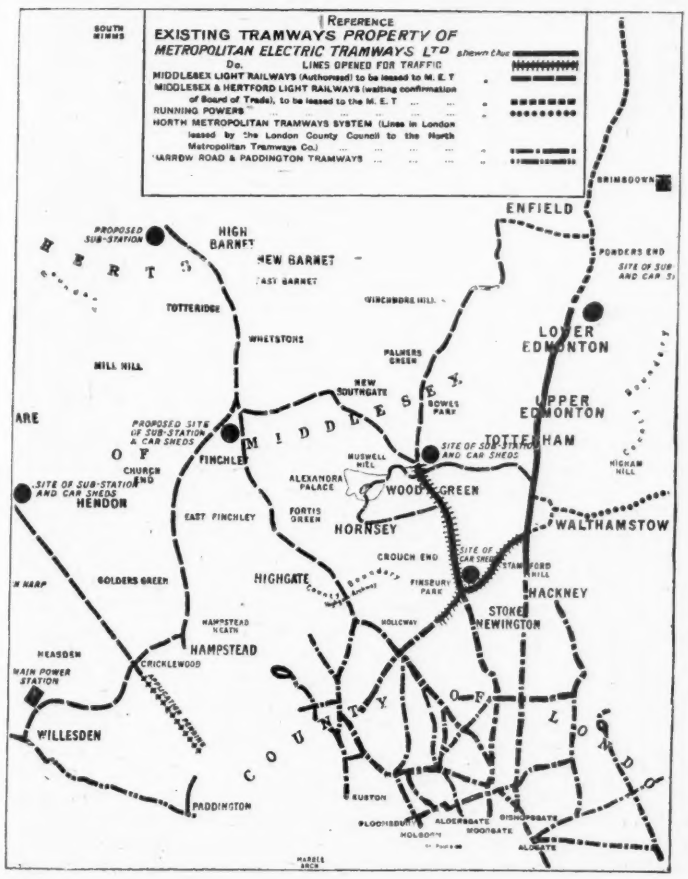
On Friday last, the first section of the Metropolitan Electric Tramways to be reconstructed for electric traction commenced operation under the new conditions, and on the same day a large party of Press representatives visited the tramways and the Brimsdown power station of the North Metropolitan Electric Power Supply Co., which supplies the power to run these tramways. The party journeyed from London to Brimsdown by special train, and was received by Mr. H. H. Perry, resident engineer, at the power station; Mr. Ruthven Murray and other members of the company's staff were also present. After inspecting the generating plant, the visitors were taken in brakes to the Edmonton depôt, where light refreshments were served, and subsequently they proceeded to the Wood Green depôt to inspect the sub-station and car-shed. *En route* from Edmonton to Wood Green, the tramways were seen in every stage of progress from the original horse haulage to the completed electric traction stage. From Wood Green special electric cars conveyed the visitors to Finsbury Park and Seven Sisters Corner, after which they were driven in brakes to Moorgate Street. The arrangements made for the comfort of the guests were admirable, and keen interest was displayed in the numerous noteworthy features of the plant in the power-station and sub-stations, as well as of the cars and depôts.

The newly-opened section comprises about four miles of double track, forming part of a system embracing 50 miles of route; 14 million passengers were carried on the company's tramways last year, and, as the fares are being reduced, coincidently with the introduction of electric traction, to the "workman's fare" rates for all classes of passengers, a greatly increased traffic may be confidently anticipated. The company is closely connected with the North Metropolitan Tramways Co., which leases the L.C.C. tramway system within the county boundaries, and the two systems are interconnected at several points, as shown on the accompanying map. The Middlesex and Hertfordshire County Councils' tramways, 38½ miles in length, will, on their completion, be leased to the Metropolitan Electric Tramways Co., and the joint systems will constitute a most important and extensive network.

The Brush Electrical Engineering Co. has supplied the first batch of 150 cars, of the double-deck type, fitted with maximum traction trucks, and seating from 68 to 74 passengers each, and the reconstruction of the tramways is being carried out by Messrs. Dick, Kerr & Co., Ltd. The special track work has been supplied by Messrs. Hadfield's Steel Foundry Co., Ltd., the points being 12 ft. long, of "Era" manganese steel. The rails are in 45-ft. lengths, weighing 101 lbs. per yard. The overhead equipment has been carried out by the company's own staff, with flexible bow-string and span-wire suspension. Messrs. John Spencer, Ltd., supplied the steel poles, and the bases were furnished by Messrs. John Forster & Co., Ltd., and Messrs. W. Lucy and Co. The trolley wire was supplied by Messrs. Frederic Smith & Co., Ltd. Messrs. Callenders supplied and laid the feeders, insulated with vulcanised bitumen, in wood troughing, over the 20 miles of route. The controllers and motors were supplied by the British Thomson-Houston Co., Ltd.

The Brimsdown power station, situated on the bank of the Lee Navigation, was equipped by the Brush Co., as general

contractors, the plant comprising six Babcock & Wilcox boilers, fitted with superheaters and chain grate stokers; three Parsons turbines coupled to Brown-Boveri alternators of 1,000 KW. each, generating three-phase current at 10,000 volts, 50 cycles per second, 1,500 r.p.m.; Mirrlees-Watson condensers, J. P. Hall & Co.'s feed pumps, four exciters driven by Belliss engines, and B.T.H. switchgear, &c. Coal is brought to the station by barge, and is handled by an electric crane and a coal conveyor, supplied by Messrs. Babcock and Wilcox. There are sub-stations at Edmonton, Wood Green, Finchley, and Hendon, the first three being fed from Brimsdown by three-core cables in duplicate, supplied by the British Insulated & Helsby Cables, Ltd. The sub-stations are equipped with transformers and rotary converters, supplied by the B.T.H. Co., which work quite satisfactorily at the frequency of 50 cycles, the generating plant being turbine driven. The whole of this work has been designed and carried out by the chief engineer of the company, Mr. A. H. Pott, assisted by Mr. S. G. Smith, who has superintended the reconstruction and electrical equipment of the whole of the tramways. The company also possesses generating stations at Willesden and Hertford, the former being that which was originally designed and erected for the Willesden U.D.C. by Mr. E. T. Ruthven Murray, who has now accepted an appointment with the company. As the company's supply will be available not only for traction, but also for electric lighting and motive power, which will be supplied to local authorities at very cheap rates, a new era of prosperity and progress is opening for the northern districts, which have hitherto been almost entirely deprived of the advantages of electrical supply.




**Middlesbrough Lighting.**—The Corporation has recently received sanction from the L.G.B. to the borrowing of £19,900 for the purpose of extending its electric lighting undertaking.

Applications for supply of energy for power purposes have been received from the Cleveland Dockyard and the Tees-side Bridge and Engineering Co.

## CORRESPONDENCE.

*Letters received after first post on Wednesday morning cannot appear until the following week.*

### Short-Circuiting Rotors of Induction Motors.

On page 55 of your issue of July 8th, an article under the heading of "Short-Circuiting Rotors of Induction Motors" appears, in which mention is made of a patent consisting of casting or fusing the short-circuiting rings direct on to the ends of the conductors which have previously been placed in the slots or holes.

There is no novelty in this; some Continental firms have used this principle for years back. Messrs. Schuckert, of Nurenberg, have built machines so, and the writer rather thinks that the Allgemeine Akt. Gesellschaft, Berlin, have also used the principle. In this country Messrs. Luth and Rosén, of Stockholm, adopted casting the rings on to the conductors about one-and-a-half years ago, and some of the machines designed by the writer and built here in Arbra have been built so, while in others the entire rotor windings, bars, and rings, have been cast into the assembled punchings, the rings being afterwards turned true.

**Aubrey V. Clayton.**

Arbra, Sweden.
*July 18th*, 1904.

### "Of the Making of Many Books."

Although the sentence of which the above words form a part was written a very very long time ago, its applicability to the present day cannot be disputed. Changes in electrical engineering practice continue, and the "making of many books" chronicling these changes and re-affirming well-known facts continues also. It is with the idea of pointing out a few of the things which render the reading of these books difficult that these lines have been written. Let us take, first, the question of symbolism. The student probably gets his first symbols from his lecturer, and, on comparing these with the symbols in the first text-book he buys, the student will more than likely find that the lecturer's symbols do not stand for the same thing as those in the text-book. Later on the student buys more books, and finds that different authors use different symbols when treating of the same subject. This leads to confusion and loss of time, as it is impossible to say at first sight whether the formula is a well-known one or not. In following the author's equations, it may not be necessary, from a purely algebraic point of view, to remember the exact meaning of all the symbols used, but it is a help to have the final equation or expression set out in well-known, and, shall I say, "standard" symbols. To take the simplest case, most people recognise $C = \frac{E}{R}$, but not so many would know $I = \frac{V}{W}$ at first sight. The standardisation of symbolism would be a boon, as at present there does not seem to be much uniformity in the matter. In the case of English translations of foreign works the symbolism, where necessary, should be translated as well, and to this end a high protective duty should be put on all departures from standard English practice, when such standard is settled If in any given book it is necessary to use the same symbol, say, N, to mean two utterly different things, then this should be stated in an "Index of Symbols." This "Index of Symbols" should form part of every book which largely uses mathematical expressions. There are books which contain indexes of this sort, but with a great many books it is necessary sometimes to turn back for some pages hunting for the meaning of certain symbols used. All the technical books a person buys are not read right through (any more

than a dictionary is read right through), but are kept as works of reference. All such books should contain a good general index, with plenty of cross references. In reading through some books one comes across a useful piece of information, and on turning to the index finds that it is not mentioned under any heading at all. Other cases there are in which an author will index a thing under an out-of-the-way heading. Take a parallel case to what is sometimes found. Suppose we wish to learn the author's views on "cheese." We look in the index and find, "cheese, see chalk." There is objection to that method of indexing, but there is greater objection when one has to look up under "Edibles," and then run the eye down the list to find "cheese." A book without an index is without the pale, and need hardly be mentioned here. Books containing tables of figures and mathematical symbols require very careful reading of the proofs, so that the list of errata may be small. Even errata in the list of errata have occurred. This making of a mistake in the correcting of a mistake must have about the dimensions of a deceleration. A book which the writer has in mind at the present moment contains no list of errata, and in certain parts there are misprints which seriously detract from its value as a work of reference. If we assume that the density of the misprints per square inch is the same in the other parts of the book, then the case of the reader is hard indeed. The mistakes alluded to would probably not be noticed by a reviewer unless he went into the details of the calculations. One has to look closely into many of the figures given to see that they have been correctly calculated. There is a case of a book having a different title on the title page from that which appears on the cover. This does not greatly matter, but it is annoying on going through the book to find that it does not mention something which *is* mentioned on the cover.

R. P. L.

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### Storage Batteries.

The contribution on "Storage Batteries" in your issue of the 22nd inst. presents many points of interest, and is refreshing, especially by reason of its marked absence of bias.

In such articles, as a rule, the shortcomings of existing types are handled first, not too gingerly, are made to do duty as a lurid background to set off the enchantments of "the invention," destined to usher in a new era, &c.—none of this here, but an honest attempt to assist others in obtaining the best results from their batteries.

Engineers and users have a playful way of professing to await impatiently the advent of the ideal storage cell, as to which vague rumours are always with us; yet, were this to be catalogued to-day for supply in unlimited quantities, they would carefully bide until someone else had given it an extensive and satisfactory trial. No dubious hazards for them, if you please, and quite right they are, too.

Standard cells of the present day fall short of perfection, certainly, but the erstwhile "inherent and natural defects" alluded to by your contributor have been remedied to a large extent, and records of efficiency and durability are available reflecting great credit on the manufacturers. The unquestionably far higher degree of uniformity secured in the production of secondary battery electrodes is due to gradual and painstaking developments, on sound scientific and practical lines, of the original Planté and Faure types. So-called inspiration and radical changes have led to expenditure of much time and money, but their contribution to progress in the main have been of a negative character. But to have rested on the laurels of improved construction and greater uniformity would have marked a limited appreciation as to the extent of desirable reform. The old style of mounting cells was deficient in numerous respects, and these drawbacks practically disappeared when suspension of the electrodes direct from the edges of glass boxes was introduced. The weight of the section is thereby more evenly distributed, ample clear space is provided below in plates for the collection of sediment, so that cleaning-out operations need only be carried out at longer intervals, and the connecting lugs between cells being placed well outside the boxes, where they are not exposed to the direct action of the spray, corroded bolts and attendant contamination of the electrolyte have ceased to trouble.

With a view to minimising the necessity for careful internal inspection, justly described by your contributor as essential if tedious, the Chloride Co., with whom it is my good fortune to be connected, adopted the practice of inserting continuous porous wood separators between all plates of opposite polarity, extending over their entire surface, thereby guarding against the possibility of interruptions occurring in the service through short-circuited plates, no matter from what cause. The reliable behaviour of these porous diaphragms has been ascertained by three years' use in the automobile batteries of the same firm, and two years' application to the stationary type of cell. Of course, we are all aware that no accumulator maker will readily concede any tendency of his plates to become buckled, yet this phenomenon has been observed; and, after all, it is a comfort to be certain that extensive damage and waste of current from this cause are impossible.

Your contributor's preference for a large number of small pellets in a pasted plate may, perhaps, be not altogether inflexible. With embedded conductors, as in the Exide pattern, thorough contact with the active material is maintained to the bitter end, and the liability of one or more of such 20 pencils or slabs in a plate, dropping out is infinitesimal compared with the same tendency in a plate composed of 300 or 400 small pellets.

In private installations the owners can only be induced with difficulty to provide charge and discharge meters, mainly on account of expense, and the attendant rarely knows, even approximately, how much has been taken out of the battery overnight. This leaves the specific gravity of the electrolyte as the only safe guide, and when a brisk action is promoted by adopting the normal charging rate recommended by the makers, the liquid of cells in regular use will not easily become stratified. It is when users compromise with the directions, charge at low current values for no end of time that mischief occurs. The specific gravity will not rise above a certain limit under these circumstances, and by pumping away till further orders, overformation and loosening of the active material result. Arresting the charge a few minutes after both positives and negatives begin to gas freely, prolonging it for about 30 minutes beyond this once a week by way of fillip, is, perhaps, as safe a plan as any. This, the invariable practice for many years of a prominent central station engineer, whose thorough knowlege of batteries and battery working is indisputable, has given entirely satisfactory results.

On the subject of maintenance, your contributor hits out wildly, not stopping short to impute deliberate trickiness and bad faith to the manufacturers, apparently losing sight of the important fact that reputations are not risked lightly, and that one bad battery may close a whole district to the makers. I am no advocate of maintenance contracts, as in vogue; they are monstrous, and no boiler, engine, or dynamo maker in his senses would care to accept similar responsibilities. But demand breeds supply, and through want of an understanding among battery manufacturers, maintenance agreements for the term of half a generation have become quite common. Question of stability as to which the insured must exercise his judgement. Some records of working and limitations as to use are, of course, indispensable, or otherwise the makers might as well sign and hand over a blank cheque, leaving the owner to fill in the amount for repairs at his discretion. Even as it is much must be taken for granted, and confidence be extended most liberally to the engineer in charge, of whose qualifications for the position there is no evidence, and who may be an unmitigated dunderhead for all the manufacturer knows. The onus of proof always falls on the latter if things go wrong, and the difficulties to be met then are best understood by those who have conducted post-mortem inquiries on a few batteries. But present-day standard cells are hardy plants, and the law of averages is relied upon to compensate for facers here as in other insurance business without recourse to "pitfalls and traps."

L. Brockman.

### Localisation of Earths.

Mr. Boot has not, in my opinion, quite established his claims in the matter of localising earths. He has not attempted the comparative costs of various systems. He is satisfied that one method is very expensive. I am sure that many of your readers welcome contributions on this subject, but parallel comments by, say, Mr. Rudyard Kipling would do much to help us as to the best method. I can imagine numerous little errors occurring which would result in the fault being "localised" once or twice in the wrong place. (R. K. would come in here.)

Still, I have no doubt that Mr. Boot is willing to give further detail. May I suggest the whole story of "The Hunting of the Snark"—I mean, "The Finding of the Fault," together with the time-sheets, as it fell out at Tunbridge Wells on a summer's day?

Mr. Boot's cables have rather a small section; Mr. Wordingham, with his column of smoke, &c., may have been thinking of a few sq. in.

By the way, in the list of apparatus, should not some regulating resistance, and an ammeter, be included, to keep the accumulator discharge within bounds?

I feel sure that Mr. Boot will make his case good, and be ready to disclose any little pitfalls that may have come to his knowledge, more particularly in applying the method he advocates to cables of larger section.

**J. Rutherford Blaikie.**

Electricity Works, Southwark.
*July 26th*, 1904.

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I have read, with much interest, Mr. Horace Boot's admirable article on "The Localisation of Earths on Feeders and Networks," and should like to make a few remarks thereon.

Mr. Boot characterises the "cut-and-try" method as "barbaric," and I quite agree with him. Though commonly practised, it is *never* necessary. The cause of its use is the commonness of the "jumped-up" man in charge, who has no right to be called an electrician, much less an electrical engineer.

Mr. Boot says further on, ". . . it is necessary for the flexible leads in fig. 1 to be of the same sectional area as the cable which is being tested; if not, allowance must be made for the length from the point of the bridge, otherwise an error will result." Now I have found this very inconvenient, because ·1 sq. in. or larger-sized flexible leads are not pleasant

FIG. 1.

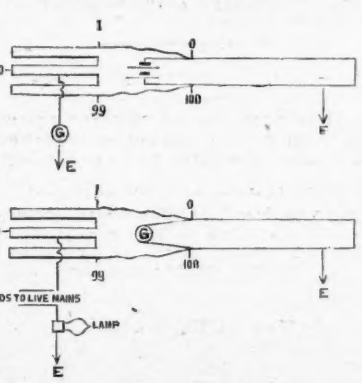


FIG. 2.




to carry about; moreover, they are not always to hand. I get over this trouble as follows:—I divide my bridge into 98 parts (it might as well be 198, or any convenient number minus 2). Then I have two flexible leads made each exactly the resistance of one division of my bridge; the bridge is numbered from 1 to 99, the two leads making 0 to 1 and 99 to 100, and the connections as shown in Mr. Boot's fig. 1, are altered as shown in sketch herewith.

The next point on which I wish to remark is this. Mr. Boot says that with this method the resistance of the fault does not matter, as the galvanometer is connected across the same. Surely this is a slip on his part? As connected in fig. 1, the galvanometer is *in series* with the fault, and its resistance *does* matter very much. It is with the fig. 2 arrangement that the resistance of the fault does not matter, but, as he says, a large battery is needed. My method is to connect as in fig. 2, using the whole station voltage with an 8 or 16-C.P. lamp in series. By this method I have found an earth on a ·1 sq. in. concentric feeder over 600 yards long, within 5 ft.

Finally, Mr. Boot says he "has found that the more services he has on a distributor, the easier it is to locate the position of a fault, because it gives an opportunity of short-circuiting the cable at many points." Now, I should like to ask, and this in no carping spirit, but purely for information, whether Mr. Boot discovered this before or after the publication of my letter in the REVIEW, No. 1,344, August 28th, 1903. Up to that date I had never heard of a method of fault-finding on a branching circuit without cutting. I inquired if my method was original, and, as nobody denied it, I flattered myself it was so. I should like to know this. Mr. Boot need not fear hurting my feelings. If he tell me it is as old as the hills, I can still console myself with the thought that I worked it out independently.

I would like to say a great deal more on this rather fascinating subject, but I fear this letter is already too long.

**G. C. Knight,**

*Chief Engineer, Finchley E.L. Co., Ltd.*

*July 26th*, 1904.

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Respecting Mr. Boot's article on testing for faults on concentric mains, I would like to ask him if he finds his method successful in proximity to the ordinary electric tramway system. The *unsteady* and powerful return currents do not always confine themselves to the rails and return feeders, and combined with passing cars render a delicate instrument nearly useless.

**Mains.**

P.S.—I think Tunbridge Wells is at present free from electric traction.

## PARLIAMENTARY.

### Tyneside Tramways and Tramroads Bill.

Sir E. Strachey's Select Committee of the House of Commons again sat on Friday to settle the clauses in the Tyneside Tramways and Tramroads Bill relating to the running powers over the Newcastle Corporation tramways, and to the fact that no increased value should accrue to the company's undertaking in consequence of such powers being granted. Mr. Balfour Browne, K.C., and Mr. L. Macassey were for the Tyneside Tramways Co., and Mr. Lloyd, K.C., and Mr. Russell for the Newcastle Corporation.

After considerable consultation between counsel, Mr. Balfour Browne said he was glad to say they had arrived at an agreement. On the first page of the Bill they had agreed on a clause making the agreement arrived at between the company and the Corporation and signed July 21st binding on the parties, and this agreement would be in the schedule of the Act. This was as to the running powers to be exercised. Then with regard to the question of the non-enhanced value, he submitted the following new Clause 18:—

"In determining the fair market value of the tramways of the company under the provisions of Section 83 of the Act of 1901, and Section 37 of the Act of 1902, the arbitrator therein mentioned shall not have regard to any increase of value in his opinion directly due to the use by the company of the tramways of the Newcastle Corporation under the agreement scheduled to this Act, and not, in his opinion, due to any natural, or other, cause affecting the volume of the traffic on such tramways."

The Chairman said that they had been furnished with a printed copy of the Clause, and he saw that the words, as read by Mr. Balfour Browne, differed from the printed Clause. He would like to know why there should be any alteration.

Mr. Balfour Browne said the only reason he knew of was to save the face of the Newcastle Corporation. Mr. Browne proceeded to go through the heads of agreement as to running powers, which were submitted to the Committee at the previous sitting, and these, with a few verbal alterations, had been agreed to. In the case of dispute the agreement provided for the appointment of an arbitrator by the Board of Trade.

Mr. Talbot said that with regard to the new Clause 18, the Corporation took no part in the wording of that, and, therefore, must not be taken to have given their assent. As they could not be the purchasing authority it was not a matter which concerned them.

Mr. Balfour Browne said that under these circumstances he would ask the Committee to adhere to the printed clause. He agreed that it was better that Mr. Talbot should take no part in the discussion on that clause. It was not a matter as between the company and the Corporation of Newcastle, but as between the company

and the local authorities through whose districts the lines of the company ran, and also, of course, for the Committee.

The Committee accepted Clause 18 as follows:—"In determining the fair market value of the tramways of the company under the provision of Sec. 83 of the Act of 1901, or Clause 37 of the Act of 1902, the arbitrator therein mentioned shall not have regard to any increase of value in his opinion directly produced by the exercise of the powers by this Act conferred upon the company of running over and using the tramways of the Corporation, and not in his opinion due to any natural or other cause affecting the volume of traffic on such tramways."

The Bill as amended was ordered to be reported to the House.

Sir Edward Strachey subsequently reported from the Committee on Group No. 9 of Railway Bills: That in the case of the Tyneside Tramways and Tramroads (Recommitted) Bill [Lords] they had reconsidered Clauses 15 and 16 of the Bill, and had agreed to the following report:—

That an agreement had been come to between the promoters and the Newcastle Corporation for the exercise of mutual running powers over certain portions of their respective tramways, and the Committee had inserted provisions in the Bill for giving effect to such agreement, and had also made provision that no increase in the value of the company's undertaking should accrue by reason of the exercise of such running powers over the tramways of the Corporation in the event of its sale to the local authorities.

That there were no other circumstances of which, in the opinion of the Committee, it was desirable that the House should be informed.

Sir Edward Strachey further reported from the Committee: That they had examined the allegations contained in the preamble of the Bill, and amended the same to make it consistent with the provisions of the Bill as reconsidered and passed by the Committee, and found the same as amended to be true, and had gone through the Bill and made amendments thereto.

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### Manchester Corporation Tramways.

This Bill came before Sir Lewis McIver's Select Committee of the House of Commons on Tuesday, 19th inst., when Mr. Lewis Coward, K.C. (for the promoters), said that the Committee would not be troubled with the Bill, as all the petitions had been withdrawn. The Bill was referred to the Chairman of the Ways and Means Committee for consideration.

The measure deals with the agreement with the Ashton-under-Lyne Corporation, by which the Manchester Corporation are to construct, or re-construct, and electrically equip the Manchester, Audenshaw and Droylsden tramways. There is also an agreement by which the Ashton Corporation are to do the same for the Ashton-under-Lyne tramways. Both corporations have running powers over the lines. The Manchester Corporation will supply the electricity required in Manchester, Audenshaw and Droylsden for working and lighting the trams, and the Ashton Corporation will provide the same for their district. Power is also sought by the Bill for the construction of several lines of new tramways.

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### Middlesbrough, Stockton-on-Tees, and Thornaby Tramways.

This Bill came before Lord Brougham and Vaux's Select Committee of the House of Lords on Tuesday, 19th inst., and was promoted by the Imperial Tramways Co., to confer on them further powers for the construction of tramways, &c. The new lines proposed by the Bill were as follows:—Tramway No. 1 (double line), 1 furlong 4·80 chains in length, commencing by a junction with the company's existing line in North Ormesby Road, near Clyde Street, passing along North Ormesby Road, Langbaurgh Place, and Smeaton Street, in which last-named street it would terminate, at a point near the eastern side of George Street. Tramway No. 2 (double line) 2 miles 6 furlongs 8·40 chains in length, commencing by a junction with Tramway No. 1 at its termination in Smeaton Street, and passing thence along Smeaton Street and New Road over the North-Eastern Railway by means of a new bridge, to the junction of Station Road and Middlesbrough Road, South Bank, from which it would pass along Eston Road, in which road it would terminate near the centre of the Grangetown subway. Tramway No. 2A (double line) 1 mile 1·50 chains long, commencing by a junction with tramway No. 2 at its termination, passing along Bolckow Road, Whitworth Road, Bessemer Street, and Station Road, terminating in the Station Road, opposite the entrance to Eston Grange Station. Tramway No. 3, as originally proposed, was 1 mile 4 furlongs in length, but it was amended according to instructions of the Standing Orders Committee. In the present Bill it was stated to be 6 furlongs 0·39 chains in length. It would commence with a junction with the company's existing tramway in Middlesbrough Road, terminating in that road at the boundary between Middlesbrough and the parish of Linthorpe. Tramways Nos. 4 and 5, short lines, were struck out by the Standing Orders Committee.

The promoters were represented by Mr. Balfour Browne, K.C., Mr. Lewis Coward, K.C., Mr. Roskill, K.C., and the Hon. E. E. Charteris.

In opening the case for the promoters, Mr. Balfour Browne said that it was proposed to run tramways from North Ormesby to Grangetown. An order for the purpose of applying electricity to the existing tramways was obtained in 1897. The promoters now proposed to go to the large expense of carrying the tramways over the existing railways, and the expense of the work would be further increased by the fact that the lines would pass through the Middlesbrough Estate, where there were not yet any public roads. The existing roads had toll-bars, for which the owners would have to be compensated. The construction of the line was estimated to cost £200,000. Where the line passed through Thornaby, the single line would be taken up, and a double line constructed. This work would be done entirely in the district of Thornaby, and the new lines would not go into Middlesbrough at all. Middlesbrough was practically the only opponent to the Bill. In the east side of the town, the promoters' undertaking would run for 325 yards through the Middlesbrough district. It had been arranged to pay Thornaby £200 per mile in lieu of a share of the profits, and the object of Middlesbrough in coming there was to coerce Thornaby into an arrangement to buy up the promoters' undertaking in seven years instead of 21 years. It would be impossible to construct the tramways if such a condition were imposed. The promoters were willing to place Middlesbrough on exactly the same footing as Thornaby, who had now withdrawn their opposition.

Mr. Hans Hamilton (for the Middlesbrough Corporation) said that under the provisional order of 1897 Middlesbrough was entitled to £200 a year in respect of every route mile of single or double line worked within their boundary by the promoters.

Mr. Coward said that the suggestion was that Middlesbrough should be paid £1,000 a year in respect of the 325 yds., and the promoters could not agree to that. After further discussion, it was agreed that the Corporation should purchase the 325 yds. under the Tramways Act.

Mr. J. Clifton Robinson, the engineer to the scheme, was then formally examined, and the preamble of the Bill was found proved.

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### Royal Assents.

Among the Bills to which Royal Assent was given on Friday last week were the following:—

Harrow Road and Paddington Tramways Bill.
Baker Street and Waterloo Railway Bill.
Clyde Valley Electric Power Bill.
Plymouth Corporation Bill.
Barrow-in-Furness Corporation Bill.
Wolverhampton Corporation Bill.
Doncaster Corporation Bill.
L.C.C. Money Bill.
Birkdale Improvement Bill.
Southport and Lytham Tramroad Bill.
Derbyshire and Nottinghamshire Electric Power Bill.
Leicestershire and Warwickshire Electric Power Bill.
Charing Cross, Euston and Hampstead Railway Bill.
Shipley Urban District Council Bill.
North-Western Electricity and Power Gas Bill.
Soothill Nether U.D.C. Tramways Bill.
Glasgow and South-Western Railway Order Confirmation Bill.
South-Western and Isle of Wight Junction Railway (Extension of Time) Bill.
Govan Corporation Order Confirmation Bill.
Electric Lighting Order Confirmation (No. 5) Bill.
Leith Corporation Tramways Order Confirmation Bill.
Paisley District Tramways Order Confirmation Bill.

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*Ilford Urban District Council Bill.*—When this Bill came before the Police and Sanitary Committee of the House of Commons on Monday, Mr. Vesey Knox, who appeared for the promoters, stated that all the electrical portion of the Bill had been struck out owing to the House of Lords Committee having imposed upon them the Bermondsey Clause. The remaining portion of the Bill (street widenings and certain police and sanitary clauses) was then considered, and the preamble of the Bill was found proved.

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## LEGAL.

### Case under the London Building Act (1894).

At Marlborough Street Police Court on Monday Mr. Kennedy heard a summons taken out by Mr. T. H. Watson, the district surveyor for the St. George's, Hanover Square, district, against Mr. Sclater, an electrical engineer, of 182, Oxford Street, W., for failing to give notice of his intention to fix certain woodwork in connection with the rewiring for electric light of No. 36, Curzon Street, W.

Mr. Watson said that on June 29th last, he visited the house, and found men engaged in fixing wood for electric lighting on the second floor. Part of the work was the inserting in the wall by the fireplace of a wooden box, about 3 in. square by 2½ in. deep, for the purpose of containing an electric switch. No notice had been given of the intention to carry out the said work, and he considered that such a work was one that required notice under Sec. 145, Sub-sec. 8, of the Building Act.

In reply to the magistrate, Witness said that the box was let into the plaster, and then some of the brick behind was chipped away, so as to allow it to lie flush with the surface of the wall. Where the box was let into the wall, the brickwork was only 4½ in. thick,

as there was a flue at the back. The way the box was fixed was dangerous, as not only was the thickness of the brick reduced by chipping, but it was still further reduced by a hole drilled in the brick for the reception of a wooden plug. Such plug would, therefore, be only 1½ or 2 in. from the flue, and the Act said that no plug was to be permitted within 6 in. of a flue.

Cross-examined by Mr. Moore (for Mr. Sclater): He took the measurements himself, but he did not measure the distance of the plug from the flue.

A specimen of the kind of box used was here handed to the magistrate.

Further cross-examined: Witness knew that the box had since been removed.

Mr. Moore, addressing the magistrate, contended that the box and plug were not woodwork within the meaning of the Act.

The Magistrate said that there were facts in dispute, the distance of the plug from the flue, and it was little use arguing until those facts had been cleared up one way or the other.

Mr. A. W. Sclater was then called. He said that he was an Assoc. M.I.C.E., a M.I.E.E., and was formerly consulting electrical engineer to the School Board for London. He described what had been done at the house in question, and said that not more than ½ in. of brick had been chipped away. After he received the first letter calling his attention to the matter, he visited the house and ordered the plug to be taken out, and this was done by chipping away the brick. It was then found that there was another brick behind. Witness produced plans showing the position of the flues in the chimney heart. He was of opinion that the plug was not less than 9 in. from the flue and was most likely not nearer than 15 in.

After some cross-examination, the Magistrate again remarked that it was a question of fact.

Mr. Wm Gardner, an electric light fitter in the employment of Mr. Sclater, corroborated evidence with regard to the removal of the plug, and the finding of another course of bricks behind.

Mr. Moore then addressed the magistrate at some length. He said that Mr. Sclater had not been charged with having committed any offence other than failing to give notice. He called the magistrate's attention to a decision of Mr. Justice Wills in the case of Venner *v.* McDonnell, in which the Judge had said that some limit must be put upon the meaning of the word "structure." He asked his Worship to dismiss the application.

The Magistrate said that he was of opinion that the work was not a work within the meaning of the Act, and that it was not necessary for notice to be given.

Mr. Moore applied for costs, but the magistrate said that he could not allow costs.

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### Chepstow Gas Co. *v.* Chepstow Electric Lighting Co.

In connection with this action, which is on the Crown paper list, counsel for the Electric Lighting Co. on Friday last, before Mr. Justice Bigham and Mr. Justice Phillimore, sitting as a Divisional Court of the King's Bench Division, applied that under the special circumstances the date of the hearing should be advanced. The action was for interfering with the mains of the Gas Co., and there was a penalty of £1 per day going on. Counsel for the Gas Co. did not object, but Mr. Justice Bigham said the Lord Chief Justice had exhausted the Crown paper list, and he did not think it would be convenient to form another divisional court before the Long Vacation. He also did not think the circumstances were sufficiently pressing to warrant them in taking the course suggested.—The case will, therefore, come on for hearing in the ordinary course.

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### Geneva Tramways.

Mr. Justice Warrington, in the Chancery Division this week, heard the action of Chaplin, Milne, Grenfell & Co., Ltd., against L. Hirsch & Co., in which the plaintiffs claimed rescission of an underwriting contract in connection with the promotion of a company for the purpose of constructing and working a system of electric trams at Geneva, and further claimed the repayment of £250,000 which they had subscribed.

A syndicate, of which the defendants were members, took up the original shares in the Swiss company, and provided £300,000 for working the scheme. They decided to extend the system, and sent a circular letter to members of the syndicate inviting further subscriptions to the amount of £550,000. The invitation was not responded to to any considerable extent, and negotiations were entered into with the plaintiffs, who, on the strength of representations in the circular letter to the effect that the concern would realise yearly receipts of 30,000 fr. gross per kilometre, agreed to assist the defendants, and actually paid £250,000. The actual receipts were much less, and the working expenses much greater, than had been represented, and the plaintiffs therefore asked for rescission of the contract on that ground, though they made no charge of fraud.

His Lordship gave judgement on Tuesday for defendants with costs, holding that the circular contained representations of what was shown by the reports of others, and not representations of fact by the defendants, and could not be relied upon as justifying a claim for rescission.

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### Edison & Swan United Electric Light Co., Ltd.

In the Chancery Division, on Tuesday last, Mr. Justice Joyce heard a petition by this company for the reduction of its capital by writing off £58,910.

Mr. Macnaghten, K.C., said the company was formed in 1885; since 1901 no dividend had been paid, and large sums had had to be written off the capital in consequence of losses. The business was that of manufacturers of lamps and appliances for the purposes of electric lighting, in regard to which three valuable master patents had now expired.

Mr. Justice Joyce sanctioned the reduction, and directed its advertisement for three months.

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### Schulz *v.* Baker, Bauer & Co.

This case, which was heard at the Manchester Assizes last week, and was described by Mr. Justice Jelf as one of the most intricate he had ever dealt with, was a claim for commission, and there was a counter-claim on the part of the defendants for services, &c. The plaintiff is the inventor of an electrical accumulator, manufactured at Raab, in Germany, and patented in Great Britain and several other European countries. The defendants were his agents in this country, selling on commission. Under the terms of their agency they sold an accumulator to the Batley Corporation. Afterwards disputes arose; the defendants asked for better terms on account of the great expense incurred in endeavouring to introduce the plaintiff's accumulator, and much correspondence took place, the plaintiff holding the defendants to their original agreement. The defendants, it appeared, obtained payment from the Batley Corporation for the accumulator sold to them, and retained the money against the remuneration which they claimed. This the plaintiff now sought to recover. The defendants' claim for remuneration was based on a collateral verbal agreement, made in Cologne on the occasion of a visit to Germany by Mr. Bauer, namely, that his firm should be paid £350 to meet expenses, &c. The judge asked the jury to say whether, upon the evidence, the defendants were promised the sum referred to on condition of their continuing the agency. Other questions involving considerations of law, his Lordship said, would be for himself.

The jury (says the *Manchester Guardian*) after a short deliberation, answered the judge's question in the negative. Judgement was thereupon entered for the plaintiff for £520 6s. 8d. on the claim and counter-claim.

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### Wallace *v.* Western Electric Co. and Londonderry Corporation.

At the Londonderry County Assizes last week, Catherine Wallace, wife of Thomas Wallace, district manager of the Law Life Insurance Society, brought an action against the Western Electric Co. and the Londonderry Corporation to recover damages for injuries received through tripping on the footpath in Bishop Street on the night of January 28th. The case was heard by special jury. Counsel explained that at the time the accident occurred the Corporation were engaged in laying the cables in connection with the private electric lighting supply. The footpaths were opened up for this purpose, and the plaintiff alleged that it was owing to the careless manner in which the pavement was re-laid that the accident occurred.

For the defendants it was contended that no evidence had been given to prove negligence. The work at this place had been done in the same manner as it had been throughout the whole city of Londonderry, and they would prove that it was done most carefully and expeditiously.

The jury found for the plaintiff, and assessed damages at £321.

His Lordship gave judgement accordingly with costs.

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### Tonge *v.* Salford Corporation.

At the Manchester Assizes last week, before Mr. Commissioner Lawrence, Samuel Tonge, a grocer, of Swinton, claimed damages from the Salford Corporation for personal injuries sustained as a result of a collision betwen an electric car and his trap.

The jury found for the plaintiff for £81 16s. special damages, and £150 personal damages.

Judgement was given accordingly.

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### Desmond *v.* Cork Electric Tramway and Lighting Co.

At the Cork Assizes last week Miss H. F. Desmond obtained an award of £550 damages from defendants in respect of injuries received in a collision that occurred between two electric cars in August, 1903.

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**Electrolytic Behaviour of Tin, Antimony and Bismuth.**—K. Elbs and H. Thümmel have carried out experiments on the dissolution of the above mentioned elements in such electrolytes as sodium chloride, sodium sulphate, hydrochloric and sulphuric acid, under very different conditions as regards current density, temperature and concentration. They find that tin always goes into solution at the anode almost entirely in the divalent (stannous) state; that only sodium chloride and hydrochloric acid act as electrolytes for antimony, which yields trivalent (antimonious) compounds exclusively; and that bismuth behaves similarly to antimony.

## BUSINESS NOTES.

### Electrical Wares Exported.

| Week ending July 28th, 1903. | | Week ending July 26th, 1904. | |
|---|---|---|---|
| Amsterdam .. .. .. | Value £119 | Amsterdam .. .. .. | Value £49 |
| Bombay .. .. .. .. | 138 | Antwerp. Elec. fuses .. .. | 272 |
| Buenos Ayres .. .. .. | 49 | Bombay .. .. .. .. | 77 |
| ,, Teleph. mat. .. | 237 | Buenos Ayres .. .. .. | 745 |
| Calcutta .. .. .. .. | 479 | ,, Elec. machinery | 1,950 |
| Cape Town .. .. .. .. | 873 | ,, Teleph. mat. .. | 400 |
| Colombo .. .. .. .. | 73 | Calcutta .. .. .. .. | 1,842 |
| Copenhagen. Teleg. cable .. | 950 | ,, Elec. machinery .. | 878 |
| Delagoa Bay .. .. .. | 64 | ,, Teleg. mat. .. .. | 599 |
| ,, Teleg. apparatus | 160 | Cape Town .. .. .. .. | 348 |
| Durban .. .. .. .. | 1,422 | ,, Teleg. mat. .. .. | 350 |
| ,, Teleg. mat. .. .. | 47 | Durban .. .. .. .. | 159 |
| East London .. .. .. | 364 | ,, Elec. machinery .. | 722 |
| ,, Teleg. mat. .. | 332 | East London .. .. .. | 42 |
| Flushing .. .. .. .. | 12 | Ghent .. .. .. .. | 10 |
| Gibraltar .. .. .. .. | 122 | Hamburg. Elec. primers .. | 500 |
| Gothenburg. Teleg. mat. .. | 24 | ,, Elec. machinery .. | 28 |
| Launceston .. .. .. | 17 | Hong Kong .. .. .. .. | 75 |
| Lisbon .. .. .. .. | 47 | Lyttelton .. .. .. .. | 299 |
| ,, Teleg. mat. .. .. | 276 | Madras .. .. .. .. | 147 |
| Madras .. .. .. .. | 141 | ,, Elec. machinery .. | 908 |
| Malta .. .. .. .. | 10 | ,, Teleg. mat. .. .. | 43 |
| ,, Teleg. mat. .. .. | 48 | Melbourne .. .. .. .. | 128 |
| Ostend .. .. .. .. | 30 | Ostend .. .. .. .. | 30 |
| Paris .. .. .. .. .. | 1,304 | Otago .. .. .. .. .. | 84 |
| Perth .. .. .. .. .. | 69 | Penang .. .. .. .. | 287 |
| Port Elizabeth .. .. .. | 110 | ,, Elec. instruments .. | 36 |
| Rotterdam .. .. .. .. | 38 | Perth .. .. .. .. .. | 195 |
| Samarang .. .. .. .. | 10 | ,, Teleg. mat. .. .. | 56 |
| Shanghai .. .. .. .. | 201 | Rangoon .. .. .. .. | 129 |
| ,, Teleg. mat. .. | 102 | Riga .. .. .. .. .. | 145 |
| Singapore .. .. .. .. | 67 | Rio Grande .. .. .. .. | 277 |
| ,, Teleg. mat. .. .. | 39 | Rio Janeiro .. .. .. .. | 34 |
| Sydney .. .. .. .. | 39 | ,, Teleg. apparatus .. | 57 |
| ,, Teleg. mat. .. .. | 1,227 | ,, Telephones .. .. | 300 |
| Wellington .. .. .. .. | 123 | St. Petersburg .. .. .. | 479 |
| Yokohama .. .. .. .. | 340 | ,, Teleg. mat. .. | 60 |
| | | Santos .. .. .. .. | 10 |
| | | Shanghai .. .. .. .. | 18 |
| | | ,, Elec. machinery .. | 350 |
| | | Singapore .. .. .. .. | 74 |
| | | Sydney .. .. .. .. | 762 |
| | | ,, Elec. machinery .. | 992 |
| | | ,, Teleg. mat. .. .. | 40 |
| | | ,, Teleg. cable .. .. | 662 |
| | | Tokio. Elec. cable .. .. | 2,090 |
| | | Toronto. Elec. cable .. .. | 1,083 |
| | | Vancouver. Sub. teleg. cable .. | 6,100 |
| | | Yokohama .. .. .. .. | 222 |
| Total .. | £9,703 | Total .. | £25,090 |

### Foreign Goods Transhipped.

| | | | |
|---|---|---|---|
| Cape Town. Elec. appar. | Value £273 | East London. Elec. mat. | Value £800 |
| ,, Telephones .. | 1,193 | Calcutta. Elec. apparatus .. | 25 |
| | | Rangoon. Teleph. apparatus .. | 985 |
| | | Rio Janeiro. 217 lds. fir teleg. poles .. .. .. .. .. | — |
| Total .. .. | £1,466 | Total .. .. | £1,310 |

**Rules for Electro-Motors.**—The following revised rules for motors in textile and corn mills, and other places where the motors are exposed to dust and flyings, have been issued by the Associated Fire Offices:—

1. Motors, when not in an engine room or in a separate compartment expressly set apart for their use and built of or lined with incombustible material, must be completely enclosed in an efficient metal case forming part of the designed construction thereof.

Ventilation by direct communication with the outer air, or by openings in the vertical portion of the metal case protected by two thicknesses of approved wire gauze, is allowed.

Induction motors may have unprotected ventilation openings in their metal cases, the superficial area of each opening not exceeding ¼ in., and the openings being at least ¼ in. apart. Slip rings and brushes or any other sliding contacts must be completely enclosed in metal cases.

Inspection holes fitted with plate glass are allowed.

2. No unprotected woodwork or combustible material must be within 18 in. of any motor, and wood flooring beneath any motor must be protected by a sheet of metal.

3. The motor pulley (or other mechanical device for transmitting power from the motor) must be external to the metal case enclosing the motor. Only the shaft and the connecting conductors may be carried through into the metal case or through the wall of the compartment. No belts, ropes, or other corresponding gear may be so carried. Note.—Holes in the case to admit connecting conductors must have proper bushings, and exposed terminals must have proper protecting caps fitted, to prevent short-circuiting. Each connecting conductor must be provided with a proper switch and proper cut-out.

4. Dynamos must be treated as motors.

5. Resistances and starting transformers must be similarly situated, and must be enclosed as required for motors.

6. All metal cases, tubes, &c., must be efficiently connected to earth.

7. Motors must not be supplied with current from dynamos or conductors having an earth return.

It will be seen that an important concession is made in rule 1, which allows induction motors to be provided with unprotected ventilating openings ½ in. square or $\frac{5}{16}$ in. diameter.

**The Cape of Good Hope.**—The Customs authorities of the colony of the Cape of Good Hope have lately given a decision to the effect that "cut-outs, electrical fittings," are to be classified under No. 144 of the Tariff, the duty being 10 per cent. *ad valorem*.

**Ediswan Novelties.** — Amongst other new electric lighting accessories of the Edison & Swan United Electric Light Co., Ltd., those illustrated herewith are of interest. Fig. 1 shows a section of a two-way "Wedge-Tumler" switch of the pear pattern,

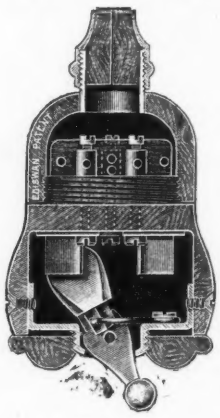



Fig. 1.

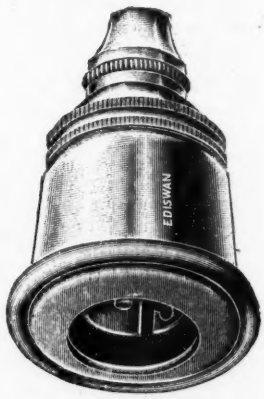



Fig. 2.

two-thirds full size. This is suitable for high-voltage circuits, having a quick and long break, while the chamber is lined with asbestos and mica. Fig. 2 shows a dust and damp proof adaptor, consisting of an india-rubber washer fitted on a brass liner, which slips over the holder, as shown in the illustration. The lamp cap is pushed through the hole in the washer, which closes upon the neck of the bulb and makes a tight joint. Fig. 3 illustrates a two-pin wall socket, with "S" insulators of white

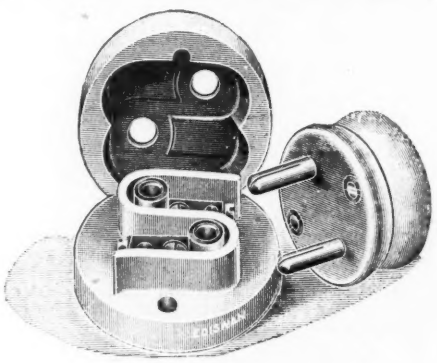


Fig. 3.

porcelain. When the cover is in place, the live parts are completely enclosed in separate compartments. A large variety of other accessories, covering almost all possible requirements from lampholders to switchboards, are described and illustrated in Section III of the 1904 catalogue, which has recently been issued, and can be had on application at Ediswan Buildings, Queen Street, E.C.

**Paterson Purifiers.**—Among recent orders received by the Paterson Engineering Co., Ltd., for their boiler-feed purifiers are the following:—

Babcock & Wilcox, Ltd., greasy condensation water purifier for H.M. Dockyards, Pembroke.

Edwin Danks & Co., Ltd., greasy condensation water purifier for H.M. Dockyards, Chatham.

Bellis & Morcom, Ltd., for their Ledsam Street works.

Ealing Electricity Works, combined exhaust steam heater, softener and condensation water purifier. (This is a duplicate of the plant supplied last year.)

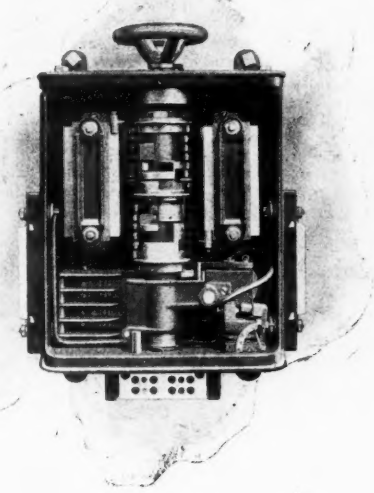
**Bankruptcy Proceedings.**—A receiving order has been granted against Harold Powell, electrical engineer (lately commission agent), of 47, Northumberland Street, Derby, on his own petition.

At a meeting of the creditors of Jas. Wm. Hunter and Albert Clapham, trading as the Yorkshire Motor Car and Electric Engineering Co., at 101 and 103, Kirkstall Road, and 8, Queen Victoria Street, Leeds, a statement was presented showing liabilities amounting to £3,106 1s. 8d.; assets, £2,220 9s. 10d., and a deficiency of £885 11s. 10d. A composition of 5s. in the £ was offered, but not accepted, and it was resolved to ask debtors to file their petition in bankruptcy.

The estates of J. Pearce & Co., electrical engineers, 212, Bath Street, Glasgow, and H. J. Robertson and J. Martin Carr, were sequestrated on July 23rd.

**Embezzlement.** — At Barnstaple on Friday, Edward Eyes, manager of the Barnstaple branch business of Messrs. H. A. Willey & Co., Ltd., electrical engineers, of Exeter, was charged with embezzling £36 10s. 6d. Accused had only been in the employ of the prosecutors for a year, and a plea of guilty was entered. It was stated that the total defalcations amounted to £130. Prisoner was sentenced to four months' hard labour.

**New Motor Starter.**—The Sunbeam Lamp Co., Ltd., of Gateshead-on-Tyne, are placing upon the market an improved motor starter for direct current shunt motors, made by Messrs. Reyrolle & Co., for whom they are the sole selling agents. It is of the "Controller" type, and is designed to meet severe conditions of service. It is similar in external appearance to a tramway motor controller, and is suitable for use on outside work, in shipyards, &c., where reliability and durability, combined with ease of manipulation, are of the first importance. The apparatus is totally enclosed in an iron case, and is thus weather and rain-proof. The terminals



REYROLLE'S MOTOR STARTER.

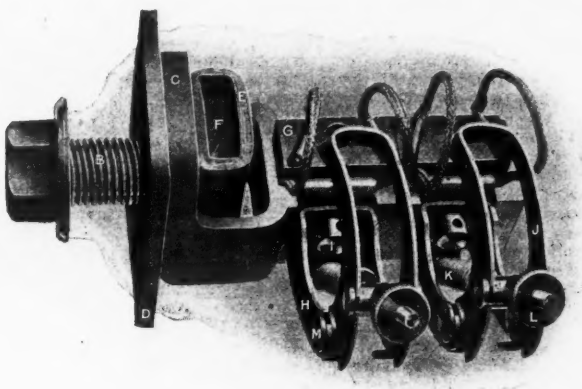
are all contained in a porcelain block, and connections may safely be made without removing the cover; a double-pole switch is contained in the starter, so that all the motor connections are "Dead" when the starter handle is in the "Off" position. The resistances are self-contained and of the Reyrolle special patented design. The apparatus is entirely self-contained; no further fuses or switches are required for connecting a motor to the supply mains. A reliable interlocking arrangement prevents the starter handle being left in an intermediate position, and a similar arrangement prevents the armature circuit being closed if the field circuit be broken.

**Screw Guy Anchors.**—A very useful device for staying poles for overhead telegraph, telephone, electric traction, or power circuits &c., is being brought out by Mr. Fred. J. Down, of 6, 7 & 8, Crutched Friars, E.C. These little screw anchors are made in six sizes, from 3½ in. to 12 in. in diameter, holding strains from 5 to 60 tons respectively, and all digging, filling and tamping is avoided. They screw in at any angle desired, and so quickly, that their whole

TYPES OF SCREW GUY ANCHOR.

cost is practically saved owing to the short time and small amount of labour required to fix them, the largest size being installed in 20 minutes. Although so hard to pull out, they can be screwed out in a few minutes, leaving scarcely any mark behind them. This is handy, if on private property, or if a pole line is to be shifted. They are equally convenient for staying large iron chimneys, derricks, &c. The three smaller sizes, and the rodless anchor, are screwed in with a special wrench; the larger sizes have strong enough shanks to be screwed in without one.

**Universal Patent Brush Gear.**—We mentioned in our articles on the Colliery Exhibition this novel brush gear, which is being introduced by Mr. Archibald Campbell, of 27, Chancery Lane, W.C. The following particulars of its construction will probably be of interest to our readers. In the accompanying illustration, B is a set pin which passes through the rocker or brush holder carrier, and which is uninsulated from the rocker, but insulated from the brush box C by means of a washer and sleeve D, and a cover E for the nut F into which the set pin is screwed. The brush box C is provided with a slot in the shoulder so as to permit of radial adjustment. The copper-plated brush G has soldered to the top of it a




UNIVERSAL PATENT BRUSH GEAR.

contact plate, carrying a soft flexible conductor soldered into the lugs at its corners, and in the body of it is clamped a copper contact plate for making contact with the brush box C. This plate is clamped up between the spring bracket H and the brush box C by means of a set pin I. Pressure is brought to bear on the top of the brush by a finger J, held in position by a spring K, with adjusting screw and nut L. The hinge between the bracket and finger is formed by a stud, M, with two grooves, one for the bracket and one for the finger. One of these grooves is closed over the finger, securing the stud in place. It is a tight fit for the slot in the bracket. The bracket H and finger J are made from steel stampings, and it will be seen that the bracket and finger are attached to the brush box by a single screw, on easing which, by means of a tommy provided with the brush gear, the brush can be removed from the holder for inspection or renewal. It will be seen that the essential conditions for success are complied with, the brushes and gear being light, adjustable, accessible, well insulated, and well connected with the current-carrying parts.

**Catalogues and Lists.**—We have received from MESSRS. W. T. GLOVER & CO., LTD., of Trafford Park, a copy of their excellent revised catalogue of electrical wires and cables, which has lately been issued. In addition to the inclusion of their well-known vulcanised rubber cables, several new features have been introduced, notably the classifying of their various types of "Diatrine" paper lead-covered cables for lighting and power mains, suitable for either low or high voltages. These cables, it is announced, can now be subjected to Glover's patented method of testing by hydraulic pressure, which they claim to be more effective than the usual 24 hours' water immersion test. Among the several types of cables recently introduced by Messrs. Glover, are their "Diatrine Paper Leadless" cables, for underground mains and mining work; "Bitumen Insulated" cables, specially suitable for solid systems; "Leather Sheathed" cables, specially suitable for rough usage; "Fire Resisting" cables, for switchboard connections for train, theatre, and ship lighting, &c. (It is reported that some thieves recently stole some of Glover's fire-resisting cable, and tried to burn it; the cable, however, was uninjured.) A handy finger index separates the various sections. As usual there are valuable tables, giving details of conductors, differences of wire gauges, also Institution rules, conversion tables, &c.

MESSRS. SIMMONDS BROS., LTD., of Newton Street, High Holborn, have brought out a new catalogue of their electric light fittings. It is divided up into two sections, one illustrating the various types of picture lighting, bracket, electrolier and other types of fittings which they hold for hire for temporary lighting, and the other showing the various designs held for sale, and giving their prices.

MESSRS. H. T. BOOTHROYD, HYSLOP & CO., of Rimrose Works, Bootle, are circulating a new illustrated price list of their E type continuous current shunt-wound motors, type S direct-coupled generators, steam engines (high-speed vertical) for dynamo driving, also electric lifts, winches and water-tight motors. Full specifications of the motors and generators are given.

The GENERAL ELECTRIC CO.'s July "Progress Sheet" contains particulars of a new pattern switch and cut-out board. The fuse terminals of these boards are each mounted on separate china slabs,

and are constructed with a view to allowing easy and effectual replacement of fuses. They are intended for circuits up to 250 volts. Several novelties in adjustable brackets and shelf clips for electric light fittings are also illustrated. A new form of protected wall plug is shown, and new prices are given of screwed brazed "Union" steel conduit.

A list of their type No. 93 Mordey's patent fuses has been received from MESSRS. ERNEST F. MOY, LTD.

Mr. S. W. Cuttriss, of Prudential Buildings, Park Row, Leeds, has written a pamphlet on "The Industrial Application of Electric Motors," and in the course of some 13 pages, he endeavours to "place before the practical business man a few facts and figures—the result of actual experience—which it is hoped will prompt him to study the matter (electric driving) more thoroughly." A page of definitions of electrical terms, some comments on the efficiency of electric motors, the economy of electric driving, methods of charging, cost of electric generation, and the development of electric power supply companies—these are the sections of the subject touched. The section which discusses the supply of electrical energy from town mains gives some figures showing the number and H.P. of motors on circuit in connection with seven Yorkshire municipal systems, but in the case of Sheffield more up-to-date figures might have been quoted; 106 motors represents only about one-fourth of the actual total at the present moment. That, however, is but a small detail when the general object of the pamphlet is borne in mind, *i.e.*, to show the power-user what he stands to gain by the substitution of electric for the older forms of driving.

From the INCANDESCENT LAMP CENTRAL SALE OFFICE in Berlin we have received particulars of prices of their incandescent lamps ranging from 5 to 32 C.P. in various shapes and for various voltages.

MESSRS. JOHN LANG & SONS, of Johnstone, have issued a new edition of their catalogue of lathes. Their patent variable speed drive is now fitted to all sizes of lathes manufactured by them. The list contains a large number of excellent half-tone illustrations of the machines which are described in its 100 odd pages.

MESSRS. MONTE-CALLOW & Co., of 6, Ludgate Broadway, E.C., send us a leaflet describing their "Perfecta" apparatus, including lift controllers, electric pulley blocks, and patent reducing gears, with prices.

**Annual Outings.**—In pleasant weather on Saturday last the staff of the Sunbeam Lamp Co. went picnicking to Mitford—a delightful suburb of Morpeth. The party, which included the secretary, Mr. T. J. Grainger, and the assistant manager, Mr. Herbert Edmundson (the managing director being away on holiday), left the works in brakes. A substantial tea was arranged at the "Plough" by the accountant (Mr. Berresford), at which Mr. W. Young proposed the "Continued Success of the Firm." Mr. Young observed that their recent achievements augured favourably for that success, and, in responding, the secretary and assistant manager both spoke encouragingly of the future. Thanks were tendered the directors for the contribution they had made to the day's pleasure. Jest and song followed the toasts.

On Saturday, 16th inst., the Kensington branch employés of Rawlings Bros., Ltd., held their annual outing at Taplow, where over 100 sat down to dinner. After the repast there was the usual toast list, and the speeches were brief, as the rest of the day was to be spent on the river in a steam launch. Mr. W. R. Rawlings, managing director, spoke of the prosperous position of the firm in spite of keen competition, and regretted there was not a better representation of the employés, owing to the special duties which so many had to attend to. Competition was getting worse and worse every day, but the public were beginning to know that it was not always the lowest price which was the cheapest. The party joined the steam launch at 2 o'clock, and, spent about 6 hours on the river in excellent weather. After tea the prizes were distributed by the chairman to those who were successful at the sports which were held in the morning. After complimentary votes of thanks to the Committee and Mr. Banister, the secretary, the party returned home, the office staff by motor-cars, and the works staff by train, after having spent a most enjoyable day. The ladies spent a very pleasant day at Herne Bay.

The Electrical Co., Ltd., held their outing on Saturday, July 23rd, when a trip by rail from Waterloo to Staines, and by the launch *Balmoral* to Bray Lock and back, took place. Luncheon was served on board, and on the return to Staines, dinner, to which some 75 sat down, was served at the Bridge House Hotel, under the chairmanship of Mr. Stottner, the general manager, who was supported by Mr. Loewi, the secretary.

The annual sports in connection with the Southport Corporation Electric Tramways employés took place at Kew Gardens, Southport, on Wednesday and Thursday, 20th and 21st insts. About 230 employés took part.

On Saturday last, the 23rd inst., the staff and employés of Messrs. J. J. Marr & Co., electrical engineers, Moorfields, Liverpool, had their annual picnic, leaving Liverpool by train for Windermere, and proceeding thence by steamer to Ambleside. Dinner was served at the Queen's Hotel. The afternoon was devoted to boating on the lake and exploring the beauties of the neighbourhood. After tea the party drove to Windermere in coaches.

On Wednesday, July 20th, the second half of the employés of the Hastings Corporation Electricity Department had their first annual outing. They proceeded *vid* the Sedlescombe Road to John's Cross, where breakfast was served. After dinner a game of cricket, "married *v.* single," was played, and resulted in a win for the single members by 63 runs to 16.

The Swansea clerical and operating staff of the National Telephone Co. had their first annual picnic on Saturday last to Parkmill.

**Dissolutions and Liquidations.**—A meeting of the Electric Magnetic Traction Co. is to be held at Hamilton House, Bishopsgate Street, E.C., on August 26th, to receive an account of the winding up from the liquidator, Mr. J. H. Howard.

Messrs. W. F. Ibbotson and R. Green (Ibbotson & Green, electrical and mechanical engineers, Sheffield), have dissolved partnership.

A meeting of the Doe Portable Electric Light and Power Syndicate is to be held at 122, Cannon Street, E.C., on August 30th, to hear an account of the winding-up from the liquidator, Mr. J. E. Ward.

**Book Notices.**—"Proceedings of the Physical Society of London." Vol. XIX.—Part II., July, 1904.

"Die Vagabundierenden Ströme Elektrischer Bahnen." By Dr. Carl Michalke. Brunswick: Friedrich Vieweg & Son. M. 2.50

"Loci in Mechanical Drawing," By Alex. MacLay, B.Sc. Part III.—Piston Acceleration. Manchester: The Technical Publishing Co., Ltd. 2s. 6d. net.

"Transactions of the American Electro-Chemical Society." Vol. V. 1904. Philadelphia: By the Society. $3.00.

"The Physical Review." July, 1904. London and New York: MacMillan & Co., Ltd.

"Coke Ovens and Their History." By P. J. Mallmann, M.A. A paper read before the Cleveland Institution of Engineers, Middlesbrough, April 18th, 1904. From the author, 114 and 116, Victoria Street, Westminster, S.W.

"An Imperial Clearing House." By John Macaulay. Newport (Mon.): Mullock & Sons. 1904.

"Electrical Motor Installations." By F. J. A. Matthews. A book for factory owners and other users of steam power. Manchester: The Scientific Publishing Co. 2s. 6d. net.

"Quarterly Bulletin of the American Institute of Architects," January to April, 1904. Washington, U.S.A.: Glenn Brown, Sec.; the Octagon.

**Brush Contracts.**—The Brush Electrical Engineering Co., Ltd., have secured the following contracts:—

Auckland Electric Tramways Co., one 70-KW. booster.
City of Birmingham Tramways Co., two 100-KW. dynamos.
Lincoln Corporation Tramways, eight car bodies and trucks.

**Fire.**—Reuter reports that the great electric cable and wire factory of Messrs. Felten & Guilleaume, at St. Petersburg, was destroyed by fire on Tuesday. The loss is estimated at £250,000. Among the property destroyed was a large quantity of cables and conducting wires for torpedoes and mines ordered for the Baltic Squadron.

**Trade Announcements.**—The Tudor Accumulator Co., Ltd., notify that they have come to an arrangement with the Accumulatoren-Fabrik A.G., of Berlin and Hagen, and with other manufacturers of Tudor storage batteries on the Continent, in accordance with which the whole of the export trade of Tudor accumulators in future will be dealt with by the Tudor Storage Battery Export Syndicate, Milton House, 35, Surrey Street, Strand, W.C. All communications concerning Tudor accumulators for export should be sent to that address. The management of the office is in the hands of Mr. E. G. Lind, A.M.I.E.E.

The address of the Northampton Corporation Electric Tramways Department (engineer's offices), is now "Power Station, Castle Street, Northampton," instead of Guildhall. Mr. Joseph McMahon is the borough electrical engineer.

The Ajax Electrical Co. has removed its offices and stores from 78, North Street, Barking, to Ajax Works, Stanley Road, Ilford. It still has branches at Barking and Seven Kings.

**Diesel Engine Test.**—We are informed that at a recent fuel consumption test of a Diesel engine of 160 B.H.P. output, the extremely good figure of 0·37 lb. of crude petroleum per B.H.P.-hour was obtained. This is equal to one-twelfth of a penny per B.H.P.-hour with oil at 42s. per ton.

**For Sale.**—Manchester electricity department is open to receive offers (up to August 1st) for a large number of old meters of the Ferranti, Thomson, and other types.

**Cape Town Exhibition.**—It is announced that the last day for receiving applications for space in the Cape Town International Exhibition for Europe is August 15th.

**Germany.**—So far this year there has been a noticeable increase in the exports of electrical machinery from Germany, the returns for the four months ending with April last, showing a total of 4,370 tons, as compared with only 4,005 tons in the corresponding four months of 1903.

A company has just been formed in Berlin, with a capital of £6,750 to be known as Die Electromobile Gesellschaft to undertake the construction and operation of electrical motor broughams, using the Hagen type of accumulator.

**Belgium.**—A company has just been formed in Brussels with a capital of £120,000, to be known as La Société de Constructions Electriques de Charleroi. The new concern has been formed to acquire and carry on the Dulait electrical engineering works at Marcinelle and Jeumont. It is reported that the company has contracts in hand for the establishment of central stations at Liège, Charleroi, Ottignies, Hal and Haren.

**Imports of Foreign Electrical Machinery.**—The imports of foreign electrical machinery into this country were on rather a larger scale than usual, amounting to £54,633, as compared with £35,887 in the preceding month, and £52,497 in June, 1903. The aggregate imports for the six months ending with June last are returned at £269,444, which contrasts with £313,002 in the corresponding six months of 1903.

**Australia.**—The Australian Customs authorities have lately given a decision to the effect that "Fuses, porcelain," are to be classified as electrical fittings, and to be admitted free of duty.

## LIGHTING AND POWER NOTES.

**Barnet.**—Notice of the intention of the U.D.C. to transfer its prov. orders to the North Metropolitan Electrical Power Distribution Co., Ltd., is given in the *London Gazette*.

**Birtley.**—The U.D.C. has requested the Birtley Iron Co. to quote terms for supplying electricity for 200 public lamps.

**Boston.**—The borough engineer's report on the proposed electric lighting scheme recommends a generating station adjacent to the dock, and convenient to the railway, on land belonging to the Corporation. He proposes laying mains through the principal streets, and the cost of the scheme would amount to £17,263.

**Chester-le-Street.**—The R.D.C. has resolved to oppose the application of the County of Durham Electrical Power Distribution Co. for a prov. order for electric light, on the ground that if sanction were given to a syndicate the proposals of the County Council to foster a county scheme would be hampered.

**Cleethorpes.**—The U.D.C. has applied to the B. of T. for a further extension of time in respect of its E.L. order.

**Dewsbury.**—Strong representations have been made to the Corporation by the local tradesmen's association respecting the charges for electricity. Recently the association appointed a committee to inquire what the charges were in other towns, which now reports that, without exception, the price at Dewsbury is above that of neighbouring towns. The charges are not only higher than those of large towns, such as Leeds, Bradford, Halifax, and Wakefield, but also higher than those of Heckmondwike, Morley, and Batley. The Corporation has been asked to make a reduction, and the Gas and Electricity Committee has the matter under consideration.

**Dublin.**—On the 21st inst. a L.G.B. inquiry was held into the application of the Corporation for various loans, including one of £21,000 for extra expenditure on the Pigeon House generating plant. Opposition was offered by Mr. J. A. Rynd, on behalf of Mr. J. L. Mahon and Mr. Henry Forbes, who contended that the application was irregular. The inspector decided that there had been no definite resolution of the Council for the loan in question, and that the Corporation would have to hold a meeting and pass a resolution ordering application for a loan of £21,000, and then apply for the holding of another inquiry.

**East Ham.**—The U.D.C. resolved, on Wednesday last week, to apply to the L.G.B. for sanction to borrow £10,000 for E.L. purposes.

**Fort William (Bengal Presidency).**—The recently completed electrical scheme at the Fort comprises a small generating station containing three Allen-Siemens steam dynamos, two of 80 KW. and one of 40 KW.; two Crompton balancers in the engine room, five loco. boilers with a working pressure of 150 lbs. per sq. in., two feed pumps, a feed water heater and surface condenser are also installed. The distribution of current is carried out by means of overhead bare copper wire, some 16 miles being used, and the system employed is the three-wire, with 440 volts across the outers. Some 2,000 lights, 360 ceiling and 70 table fans are at present in use, and the punkahs throughout are to be worked electrically. The greater portion of the plant has been imported and erected by the Military Works Department.

**Frome.**—The U.D.C. has decided to borrow another £5,000 for electric light purposes.

**Germany.**—The municipal authorities of Liegnitz have just voted a sum of £5,000 for the extension of the electric lighting works in the town.

**Goole.**—A L.G.B. inquiry was held on the 20th inst. into the application of the U.D.C. for sanction to borrow £1,000 for electric lighting purposes, &c.

**Littleborough.**—The U.D.C. is negotiating with the Lancashire Electric Power Co. for the supply of electricity for lighting purposes.

**London.**—Stepney.—An explosion occurred in Mile End Road on the 23rd inst., through, it is stated, the fusing of the electric light mains. A hole about 20 ft. in circumference was made in the street, and several persons are stated to have been thrown down by the shock.

St. Pancras.—It was reported to the B.C. on 26th inst., that the taxed costs of the plaintiffs in the recent action of Colwell and Others *v.* the Borough Council, which would have to be paid out of the electricity account, amounted to £1 060. An application is to be made to the L.C.C. for an electric lighting loan of £10,000.

Battersea.—To prevent leakage into the basement at the generating station owing to tidal waters, the borough surveyor has prepared a scheme for laying pure bitumen and cement concrete over the whole floor area at an estimated cost of £297. Meter testing and meter store rooms are to be provided at a cost of £154, and checker plating is to be laid down in the boiler room at a cost of £124. The Lighting Committee recommends an expenditure of £3,653 for distributing mains and for 170 ½-ampere Nernst lamps.

Marylebone.—The Finance Committee of the B.C. reported at length on 26th inst., setting out the terms on which the L.C.C. will advance the loan of £1,415,000 for E.L. purposes, and stated that it had agreed to them. Agreements have been arrived at to purchase six properties required for the generating station site at a cost of £27,715, with certain fees and expenses.

Hammersmith.—The river water main is to be extended into No. 2 boiler house of the electricity undertaking, at an estimated cost of £300. Owing to the projected extensions, the whole of the vacant land adjoining the electricity station is to be allocated to the undertaking.

**Malling.**—The R.D.C. has resolved to oppose the application of the Kent Electric Power Co. for a prov. order for electric lighting in its area, unless there is evidence that the company intends to carry out the work.

**Manchester.**—A few months ago an agreement was made between the Gas and Electricity Committees for lighting round the Royal Infirmary, to demonstrate that electricity is the more economical illuminant, and equal to gas in any form. It was agreed that the Electricity Committee should light the Piccadilly side of the Infirmary, and that the Gas Committee should light the other three sides. The Electricity Committee has now completed its portion of the work, and has erected 21 Gilbert enclosed arc lamps in place of six lamps of the Crompton and Brockie-Pell type. The illuminating power of the new lamps is from 1,300 to 2,000 candles each. The Committee has decided to replace the arc lamps in Albert Square, St. Ann's Square, and St. Ann's Street with the new type of lamp.

**Melbourne.**—The annual report and statement of accounts of the Corporation electric supply undertaking for the year ended February 29th last shows a gross revenue of £64,847, and working expenses of £35,267, leaving a gross profit balance of £29,580; out of this £12,750 has been set aside for interest, &c.; £3,500 towards the sinking fund, and £7,000 to depreciation and renewals, leaving a net profit on the year's working of £6,329, as against £1,141 for the previous year. The principal items on capital expenditure were: for mains, £11,181, and the changing over of installations, £3,622. The first item practically completes the undergrounding of the mains in the central portion of the city, and the change-over in this area is to be completed during the present year. The revenue from private supply shows an increase over the previous year of £1,341 (exclusive of labour and sale of materia), and that from public lighting a decrease of £502. The gross expenditure has decreased by £6,084, and the amount transferred to the net revenue account is £6,924 in excess of that in the previous year.

During the past twelve months the undergrounding of the cables in the extension area was completed, and good progress made in the change-over of consumers from the old system to the new. The Council has reduced the price of energy for power from 3d. to 2d., as from the 1st of last month, and is contemplating making reductions in the charges for lighting, and it is suggested that a maximum demand system shall be established at 8d. per unit for the first 1½ hours, and 2d. after, in place of the flat-rate of 5d. as at present. Mr. H. R. Harper, the city electrical engineer, informs us that the question of lamp renewals is now being considered, and at the present time the electrical supply department renews about three-fourths of the lamps on the circuits, for which an extra ½d. per unit is received. Mr. Harper says that he looks upon this work as being one of the most important branches attached to an undertaking, as since it has been adopted, and the responsibility taken by the department, consumers benefit, and the standard of the electric lighting is much improved, and there is far less trouble than when consumers bought cheap German lamps. A lamp of American make is being used, as, after tests, and taking the first cost into consideration, the American lamp is found to be slightly superior to the English, and much so to the Continental. A large business is being done in private arc lighting for shops, a feature of the shops in Melbourne being the verandah covering the entire width of the pavement, and this system of lighting forms one of the best effects on such thoroughfares that could be seen anywhere. "Flame" lamps are very popular for this kind of lighting, no fewer than 200 having been installed during the past twelve months, and applications for another 100 have been received. 120 "Liliput" arc lamps have also been installed during the past few months. The total number of units sold during the last financial year amount to 3,512,760; the number of equivalent 16-C.P. lamps connected was 65,402, and the number of consumers, 1,301. 359 motors, equal to 756½ H.P., were connected; 736 arcs, and 2,927 incandescents, equal to 7,971 16-C.P. were in use for public lighting. The maximum demand recorded was 1,630 KW.

**Mirfield.**—The U.D.C. has decided to apply for sanction to borrow a loan of £4,948 for the laying of mains in the district, in connection with the E.L. scheme. The Council is to take a supply in bulk from the Yorkshire Electric Power Co. for lighting purposes only; the company is to supply energy for power purposes.

**Northfleet.**—The U.D.C. has informed the B. of T. that it is desirous that the town should be lit by electricity, and that, unless the overtures which Gravesend T.C. has made are carried to a satisfactory conclusion, the Northfleet order should be acted upon. For that purpose, a further extension of time is requested.

**Norwich.**—The T.C. has paid the sum of £500 to Messrs. Cozens-Hardy & Jewson in respect of the transfer of the undertaking of the Norwich Electricity Co. to the Corporation, including their agents' charges, the appeal of the company against their assessment to the rates, and the dissolution of the company.

**Provisional Orders.**—The following companies, &c., have given notice that they intend to apply for E.L. prov. orders for the places mentioned:—

Southern District Electricity Corporation.—Denbigh, Bideford, Swanage, Congleton, Tewkesbury.

Mutual Electricity Supply Co.—Rye, Thames Ditton, Bideford, Chingford, Wells, Sunbury, Ludlow.

Mr. G. Vaughan Fowler, of Warwick.—Fenton, Ludlow.

County of Durham E.P.D. Co.—Chester-le-Street.

Electric Supply Corporation.—Herne Bay.

Urban Electric Supply Co.—Egham.

Metropolitan Electric Supply Co.—Sunbury.

Kent Electric Power Co.—Chislehurst, Northfleet, Foots Cray, Malling, Hollingbourne.

Foote & Milne, Ltd.—Northfleet, Ludlow.

Lancashire Electric Power Co.—Golborne, Wardle.

Empire Electric Light and Power Co.—Widnes.

Shropshire and Worcestershire E.P. Co.—Dawley.

Messrs. Pressland & Frippard.—Swanage, on behalf of the Swanage and District Electric Supply Co.

The Kingsbridge and District Electric Light Co., the Abingdon Electric Supply Co., and the Stratford-upon-Avon Electric Supply Co.

**Ravensthorpe.**—The U.D.C. has decided to apply to the B. of T. for an E.L. prov. order. It is stated that if the order be obtained, energy will be taken from the Yorkshire Electric Power Co., whose generating station at Thornhill is nearing completion.

**Rawtenstall.**—At a meeting of the General Purposes Committee held on the 19th inst., it was resolved that a supply of electricity in bulk be obtained from the Lancashire Electric Power Co., for a period of five years provided suitable terms can be arranged; that the town clerk make application to the L.G.B. for sanction to the borrowing of £12,000 for the purpose of putting in force the Rawtenstall Electric Lighting Order, 1899, and that Messrs. Lacey, Sillar & Leigh prepare the plans and estimates required in connection with the application.

**Salford.**—The annual return of the electricity undertaking for the year ending March 31st, 1904, shows that the revenue amounted to £66,813, the total working costs to £23,952, and financial charges to £31,085, leaving a profit balance of £11,774. It was decided to allocate £8,000 to reserve, £2,394 to cover the previous year's deficit, and to contribute £1,380 in relief of the rates. The number of units sold amounted to 7,481,617, as compared with 4,763,623 in the previous year. The load factor rose from 22 to 26½ per cent., and some 2,002 H.P. of motors are connected up, some 954 H.P. being on hire. A contract has been entered into for supplying energy to a company employing motors aggregating 600 H.P., including a 400-H.P. motor for driving a rolling mill, and a further 3,000 H.P. of machinery is to be supplied with energy by contract with the Manchester Ship Canal Co.

**Shildon.**—The Northern Counties Electric Supply Co. has informed the U.D.C. that it has secured a new site for the electricity works, which will be completed without delay, and in view of this the Council has decided not to proceed at present with the action now pending against the company.

**Southampton.**—On July 21st a L.G.B. inquiry was held relative to the application of the T.C. for a loan of £2,000 for mains and service extensions for two years. There was no opposition.

**Spain.**—La Sociedad Electrica de Cenia has applied for a concession to erect overhead lines to transmit electrical energy to Vinaros and Benicarlo for lighting purposes.

**Stourbridge.**—Two companies have notified their intentions to apply for prov. orders for electric lighting in the Council's area, and the B. of T. has deferred consideration of the question of revoking the Council's electric lighting order for 12 months. Notice has been given to the Bromsgrove R.D.C. of the Council's intention to ask for a prov. order to confer extended powers. A draft agreement has been submitted by the Midland Electric Corporation for Power Distribution for the proposed supply of electricity in bulk to the Council.

**Sydney.**—The resident engineer has recommended the Council to prepare plans and estimates for extending the electric light to the boroughs of Glebe, Paddington, and Newtown.

**Townsville (Queensland).**—Mr. J. Williard, of Sydney, has been granted permission to put down a plant for an electric lighting and tramway system for the district, and specifications are now being drawn up.

**Walthamstow.**—The U.D.C. has decided to light Farnon Avenue by electricity at a cost of £151.

**Ware.**—The U.D.C. has sealed an agreement with the North Metropolitan Electrical Power Distribution Co., Ltd., for a supply of energy for lighting purposes.

**West Ham.**—On 26th inst. the borough treasurer submitted to the Corporation the accounts of the electrical undertaking for the year ending March 31st last. The expenditure on capital account during the 12 months amounted to £83,342, bringing the total capital outlay up to £268,511. The gross income was £30,363—£25,000 from private lighting; from public lighting, £3,096; power, £1,514; and traction, £210. The expenditure, including interest and instalments of loans, exceeded the income by £3,788. There was a credit balance of £1,689 from the previous year, and it was recommended that the deficiency thus unprovided for (£2,099) be made good from the general district fund. For two years £1,000 had been set aside to a reserve fund; the result of the past year's working does not allow of any sum being placed to reserve. In explanation of the deficiency, it was stated that the new generating station at Canning Town was in operation during the latter part of the year, as well as the Abbey Mills Station, the additional expenditure, with the additional repayment of capital and interest, being necessarily out of proportion to the increase in income.

**Wrexham.**—The L.G.B. has sanctioned a loan of £5,600 for the purpose of extending the electric light works and cables of the Corporation.

**York.**—The formal opening of the extensions at the Corporation electricity works took place on the 18th inst., the ceremony being performed by Mrs. H. V. Scott, wife of the Chairman of the Electricity Committee.

## TRAMWAY AND RAILWAY NOTES.

**Derby.**—The new municipal electric lines in London Road and Osmaston Road were to be formally declared open on Wednesday.

**East London Railway.**—Speaking at the half-yearly meeting of this railway on the 26th inst., Mr. A. E. Gathorne-Hardy said:—As to the probable electrification of their railway, he regretted to say that no progress was being made at present. He failed to see how they could be left out of the scheme when the electrification of the Metropolitan and District lines were entered upon. The report was adopted.

**Glasgow.**—The question of the provision by the Tramways Department of a tramway car siding in St. Vincent Street, one of the most important routes on the system, has been considered, and a plan prepared by the Department has been submitted and approved, on condition that no part of any car be allowed to remain stationary within a distance of 30 ft. from the west building line of Renfield Street, and that the master of works be instructed to have that portion of St. Vincent Street, between Renfield Street and Hope Street, paved with wood.

**London.**—The Highways Committee is asking the L.C.C. to vote the sum of £4,960 in order to provide roof covers for 60 of the electrical cars, in addition to those already so fitted. The estimated cost per car is about £80, but the Committee are advised that the use of roof covers in the winter months considerably adds to the earning power of the tramways.

**Newcastle-on-Tyne.**—At a meeting of the Finance Committee of the Corporation held on the 21st inst., the tramways estimates, which had been circulated among the members of the Committee, were considered and adopted without alteration. They show an estimated income of £206,400, and working expenses, including repairs, of £139,125. Interest and redemption are estimated at £64,734, making altogether £203,859. The estimated credit balance is £2,541. The Tramways Committee, in adopting the estimates, resolved that a renewal fund shall be created, and that last year's surplus shall form the nucleus of it. The Committee hopes that by a thorough revision of the whole system to considerably augment the fund year by year. The treasurer stated that the estimated balance of £2,541, which appears as a credit, is subject to qualification; it appears that the whole of the rent and arrears due to the Estate and Property Committee for land at the power station, car-sheds and pumping station, is not included. The sum of £4,400 to March is demanded, and negotiations are pending between the two committees as to the amount to be fixed. In the event of the claim to the £4,400 being sustained, the estimates would have to be amended, and the estimated surplus of £2,541 would have to be dropped, and an estimated deficiency of £1,859 inserted. There was also a matter of much greater importance. The Tramways Committee had not included in their estimates any sum for depreciation, and the attention of the Committee was therefore directed to the Act of Parliament which governed the preparation of estimates. When a sum is set aside for depreciation fund, the report says (and it would appear that the Corporation had no option but to do so), "then the estimates in that case would exhibit a further deficit equal to the amount inserted for depreciation." The report concludes by stating the modes by which a deficit can be met, but points out that at present there is no actual deficit.

**Northampton.**—The new municipal electric tramway service was inaugurated by the Mayoress last week. The Corporation purchased the system for £37,500, and converted it from a horse-drawn to an electric system at a cost of an additional £85,000. The new trams run on about nine miles of permanent way.

**Raworth's Traction Patents.**—On Wednesday last a highly successful demonstration of the practical operation of Raworth's automatic regenerative control and demi-car was given on the line of the Gravesend and Northfleet Electric Tramways Co., Ltd., by the directors. Readers of the ELECTRICAL REVIEW are already familiar with these inventions of Mr. Raworth, which seem destined to be largely adopted in electrical tramway working for reasons which we shall detail fully in a future issue. A number of engineers, tramway officials and representatives of the technical press, were taken on a trip of about three miles and back, and much interest was shown in the ingenious devices which Mr. Raworth has designed to make regenerative control not only a practical, but what is more to the point, a commercial success.

**Salford.**—The general manager of the tramways, Mr. E. Hatton, has presented a report to the Tramways Committee with regard to the work of the past year. He says:—"The total length of tramways now worked by the Corporation is 59½ miles of single track; of this 35½ miles are owned by the Corporation. Besides running powers over 5½ miles belonging to Manchester, the following lines are leased to the Corporation:—Eccles, 6¼ miles; Swinton and Pendlebury, 7 miles; Prestwich, 3¼ miles; and Whitefield, 1¾ miles. The total electrical energy used during the year was 6,102,524 units, of which 5,251,055 units were supplied by the Salford electricity undertaking, for which 2d. per unit was charged, less 2½ per cent. discount. The remaining 851,469 units were supplied by Manchester, for which only 1·49d. per unit was paid. The stock of cars on March 31st last was 150, of which 100 were of the double-deck single-truck type, and 50 double-deck bogie cars, all having staircases of the reversed type. During the year 20 of the single-truck cars were covered with outer-deck coverings, and have proved of much benefit to the travelling public. The traffic returns show largely increased receipts in the gross, though there has been a decrease in the earnings per car-mile, probably as a result of the unfavourable weather of last year. The number of passengers carried, the mileage run, and the traffic receipts were:—Passengers carried, 36,956,405; receipts, £198,422 7s. 6d.; earnings per car-mile, 10·07d.; miles run, 4,726,446. In the next previous year the figures were:—Passengers carried, 28,150,675; receipts, £144,486 2s. 6d.; earnings per car-mile, 10·25d.; miles run, 3,380,590. The highest weekly receipts were those for Whitsun week, when they amounted to £5,606 16s. 6d., the sum earned during Whitsun week of the previous year amounting to £3,632 9s. 3d. The year's working to March 31st last has resulted in a gross profit of £60,106 14s. 11d. The total capital expenditure, including original outlay, amounts to £620,069."

**Spen Valley.**—The following notice was issued on Saturday last by the Yorkshire (Woollen District) Tramways Ltd.:—"Owing to the impossibility of coming to a satisfactory agreement with the Heckmondwike Urban District Council for the supply of power, the company find it impossible to maintain the present service running through the Heckmondwike district."

**Wakefield.**—The electric tramways from Wakefield through Horbury to Ossett are nearing completion. At Ossett the overhead wires are now being fixed. Good progress has been made with the power station. It is expected that the line will be opened in about a month's time.

## TELEGRAPH AND TELEPHONE NOTES.

**Canadian Telegraphs.**—According to a special report lately drawn up, the Canadian Government now owns 6,042 miles of telegraph lines and 348 miles of cables.

**Glasgow Telephones.**—The third annual report by the Glasgow Corporation Telephone Department was issued to the members of the Town Council recently, and is commented upon elsewhere in this issue. The revenue and expenditure shows:—Proportion of rentals brought from last year, £20,714 15s. 9d.; gross revenue from rentals for year from June 1st, 1903, to May 31st, 1904, £50,968 18s. 10d.; less proportion of rentals applicable to year 1904-5, carried to suspense account, £24,170 19s. 9d.; a total of £26,797 19s. 1d.; sundry receipts (including terminal fees, £659 6s. 9d.) amounting to £2,126 6s. 4d., making the revenue £49,639 1s. 2d. The working expenditure (including Post-office Royalty, £5,007 1s. 1d., and terminal fees, £958 2s. 4d.), amounts to £29,119 2s. 11½d., leaving a net revenue at £20,519 18s. 2½d.; out of this there fell to be met £8,525 13s. 8d. as interest on loans, and £8,343 6s. 8d. for sinking fund, amounting to £16,869 0s. 4d., leaving a surplus on the year's operations of £3,650 17s. 10½d. This balance has been carried to the general depreciation fund, which with the £2,092 9s. 7d. standing to the credit of the fund at May 31st, 1903, brings the total amount laid aside for genuine depreciation purposes to £5,743 7s. 5½d. The report states that the whole plant is being efficiently maintained out of revenue, and the net amount of borrowing powers at May 31st, 1904, amounts to £333,890. The amount borrowed and not repaid as at May 31st, 1903, was £242,533 6s. 8d., and at the same date this year £42,956 13s. 4d., giving a total of £285,490. The amount of unexhausted borrowing powers at May 31st, 1904, was £48,400. The total amount of sinking fund as at May 31st, 1904, applied in reduction of debt was £16,110. The capital expenditure for the year amounted to £50,050 8s. 4d., which, with the sum of £270,732 3s. 8d. previously incurred, gives a total expenditure of £320,782 12s. The capital expenditure for the past year had been incurred in (1) joining up additional subscribers' lines to existing exchanges, (2) extending existing switchboards to accommodate additional lines, and opening new exchanges at Balmore, Duntocher, and Nelson Street, the last-mentioned being in the course of construction; and (3) new underground work for the general extension of the system, including junctions between exchanges. The estimated value of the underground, overhead, and switchboard plant not yielding revenue is £79,000. The following statement gives the work which was contemplated under the original scheme, and the work actually completed:—

| Work. | Original scheme. | Actually completed. | | |
|---|---|---|---|---|
| | | 1901-2. | 1902-3. | 1903-4. |
| Completed instruments | 5,250 | 5,479 | 9,122 | 11,405 |
| Partially completed lines | 1,200 | 8,787 | 7,387 | 9,065 |
| Switchboard accommodation | 6,050 lines | 7,060 lines | 10,826 lines | 12,062 lines |
| Pairs of cable wires | 6,450 | 14,572 | 18,171 | 21,874 |
| Mileage of pairs of wires in cables | 4,938 miles | 11,061 miles | 14,029½ miles | 17,597 miles |
| Length of trenching | 22 miles | 94 miles | 127½ miles | 143 miles |
| Pipes going out of exchanges | 32 | 126 | 135 | 150 |
| Capacity of pipes going out of exchanges. | 6,900 pairs of wires | 27,000 pairs of wires | 31,000 pairs of wires | 36,000 pairs of wires |
| Length of pipes | 32 miles | 104½ miles | 127½ miles | 140 miles |
| Length of underground cable | 31 miles | 113¾ miles | 162 miles | 205¾ miles |
| Ground poles | 2,326 | 691 | 1,799 | 2,544 |
| Roof standards | 456 | 228 | 243 | 239 |

As regards the service, the Committee at present has under consideration the existing method of operating, being of opinion that the great increase in the extent of the telephone system may render a change of system necessary. The traffic through the various exchanges has shown an increase over the previous year, the rate at the end of the year being 37 million messages per annum, counting each call as being equal to two messages. Regarding trunk messages, the rate between inward and outward messages now approaches an equality. Last year the department suffered a loss of £1,131 in terminal fees. This year the loss only amounts to £299.

The accounts came before a meeting of the Corporation and created a protracted discussion.

Mr. JAS. ALEXANDER, the convener of the Telephone Committee, in moving the approval of the accounts, said that some experts were anxious to have £3,000 set apart for the purpose of preliminary expenses, but he did not think there was any call for that in the meantime; he thought the Corporation were to be congratulated on the success of the department.

Mr. W. F. RUSSELL moved that the accounts be sent back, complaining that they had been rushed. He heard that the capital account had been watered to the extent of £17,000 for preliminary expenses; £16,110 had been written off as a sinking fund, and they had created what was called a depreciation fund of £5,743. Taking the sinking fund and the amount at the credit of depreciation, they got a sum of £1,853, and deducting from this £17,000 preliminary expenses, there remained only £4,851, which he maintained was all the depreciation and sinking fund they had provided against their total capital expenditure, and with regard to the £17,000, there was no doubt in his mind that this suspense account was created in order that it might be written off during the first few years of the life of the undertaking, and because of the failure to carry on the department without a loss, it had been debited to capital expenditure. He asked if that was honest accounting. Proceeding with his criticism, Mr. Russell remarked that the plant was seriously depreciating, and that some of it was of no use, was borne out by the fact that in three years scrap had been sold to the value of £432. He did not think it would be any stretch of imagination to say that what had realised £432 originally cost £10,000. Where was the revenue, he asked, to come from to provide even 7½ per cent. on the capital expenditure, either as a sinking fund or as depreciation. Their sinking fund and surplus revenue this year amounted to £11,994 4s. 6d., or only equal to 3¾ per cent. on their capital. Would any sane man say that this was sufficient for a telephone plant erected on the cheapest possible lines, and during the time of inflated prices, and which had to be taken over by the Government nine years hence on a fair valuation?

After further discussion the accounts were approved by a large majority.

The Telephone Department has received permission to lay pipes and cables and construct manholes in 25 additional streets.

**The Iceland Cable.**—The *Morning Post* Copenhagen correspondent telegraphs that the negotiations concerning the construction of a telegraphic cable between Denmark and Iceland are now nearing completion. The Great Northern Telegraph Co. has the scheme in hand.

**Wireless Telegraphy.**—A correspondent of the *Daily Telegraph* states that the *New York Herald's* wireless signal station on the Nantucket lightship has been discontinued. Great hardship is thereby inflicted as regards the Atlantic liners, which had been

able to communicate news of their approaching arrival in America 10 or 11 hours in advance. The Marconi system was employed, and this aroused the resentment of German competitors, who sought the assistance of the diplomatic service. The German Ambassador to the United States, acting under the direction of the Imperial Chancellor, called the attention of the American State Department to the fact that German vessels fitted with German wireless telegraph systems were precluded from communicating with the wireless station on the Nantucket shoal. The American Secretary of State then asked the Marconi Co. to co-operate in receiving and transmitting messages according to the German system of wireless telegraphy. The company replied that the difficulties were insuperable, and that the company was unable "to overturn its system and undo the work of years for sentimental reasons." The company also explained that all trans-Atlantic liners, including the German vessels, were equipped with Marconi wireless apparatus, and concluded:—"The issue raised by the German Government is academic rather than real, and shows the intent of the German Emperor to attempt to effect, through diplomatic channels, what could not be accomplished in business competition."

## Telegraphic Interruptions and Repairs:—

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Dominica-Martinique | May 9, 1902 | |
| St. Lucia-Martinique | May 9, 1902 | |
| Cayenne-Pinheiro | Aug. 13, 1902 | |
| Reissa-Issa (Yemen)-Camaran | Oct. 22, 1902 | |
| Tarifa-Tangier | Jan. 18, 1904 | |
| Dakar-Konakry | May 13, 1904 | |
| Chio-Ténédos | June 21, 1904 | |
| Paramaribo-Cayenne | July 13, 1904 | |
| Assab-Massowah | July 26, 1904 | |
| **Landlines.** | | |
| Seoul-Massampo | Feb. 18, 1904 | |
| Seoul-Gensan | Feb. 18, 1904 | |
| Anju-Ping-Yang | Feb. 25, 1904 | |
| Ninguta-Vladivostock | March 2, 1904 | |
| Moulmein-Bangkok | July 13, 1904 | |

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Belgium.**—August 10th. Tenders are being invited by the Belgium State Railway authorities at La Bourse, Brussels, for the supply and installation of the plant, &c., required for the electric lighting of the railway stations at Flenu-Central, Warquignies, Jemappes, and Quaregnon-Central.

**Bermondsey.**—August 8th. Wiring of staircases and courtyards of the Fulford Street Dwellings of the Council. See "Official Notices" to-day.

**Bulgaria.**—August 13th. The Municipal Authorities of Phillippopolis are inviting tenders until August 13th for the concession for the electric lighting of the town and for the construction and working of an electric tramway.

**Cannock.**—July 30th. Gas producers, two gas engines, two 80-KW. generators, booster, balancer, battery, switchboards, six 50-KW. transformers and cables. See "Official Notices" July 22nd.

**Dover.**—July 30th. Pumps and pipe work for the T.C. See "Official Notices" July 15th.

**Leeds.**—August 15th. Two 1,000-KW. turbo-alternators with condensers, exciters, and high and low-tension switchgear. See "Official Notices" July 22nd.

**London.**—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

**Manchester.** August 30th.—Wiring and electric lighting of transit sheds at the New Dock Works. See "Official Notices" to-day.

**Mexborough.**—August 2nd. Lancashire boiler for the U.D.C. See "Official Notices" July 22nd.

**Penang.**—August 16th. Steel rails, permanent way material, trolley poles, wire, feeder pillars, &c. See "Official Notices" to-day.

**Perth.**—August 16th. 4¾ miles tramways for the Corporation: permanent way, paving, and bonding, overhead equipment, cables, ducts, &c., cars and equipments, car depôt building. See "Official Notices" July 22nd.

**Plymouth.**—August 15th. (1) Steam alternator; (2) Lancashire boilers with accessories. See "Official Notices" July 15th.

**Santos (Brazil).**—August 20th. Power house plant consisting of producer gas plant and gas-driven alternators of a total of 400 KW. and transformers. See "Official Notices" July 22nd.

**Spain.**—August 4th. The Municipal Authorities of Fuentes de Andalucia are inviting tenders until August 4th for the concession for the electric lighting of the town during a period of 20 years. Tenders are to be sent to El Secretario del Ayuntamiento de Fuentes de Andalucia, whence particulars may be obtained.

### CLOSED.

**Birmingham.**—The City of Birmingham Tramways Co., Ltd., has placed with the Diesel Engine Co., Ltd., of London, a repeat order for two Diesel engines, each of 160 B.H.P.

**Brighton.**—The T.C. has accepted the tender of Messrs. Siemens Bros. & Co., for the supply of three-core high pressure and other cables, at £39,420, and that of the Reason Manufacturing Co., Ltd., for 12 arc lamps (at present on hire), at £4 4s. each.

At the meeting of the T.C. on July 21st, when the matter came forward, it transpired that Messrs. W. F. Dennis & Co. had tendered at £1,320 below the above figure, and it was explained that if the lowest tender had been accepted, the cables would have been made in Germany, and the engineer would have to go there to inspect and test the cables. Councillor Jarvis moved the acceptance of the tender of Messrs. W. F. Dennis & Co., on the ground that the ratepayers could not afford £1,300 for "this national cause." Alderman Buckwell, in supporting the recommendation, said they ought to do what they could towards the promotion of English trade. Only three voted for Councillor Jarvis's motion, and the recommendation was adopted by a large majority.

**Brighton.**—The T.C. has ordered 100 new telephone instruments from the International Electric Co., at £2 6s. 3d. each for the wall type, and £2 9s. 3d. each for the desk type. A low price was quoted on the understanding that if these 100 are satisfactory a further 400 will be taken.

**Buxton.**—The U.D.C. has accepted the tender of Callender's Cable and Construction Co., Ltd., for the supply of cables.

**Chester.**—The T.C. has accepted the following tenders:

Sunbeam Lamp Co., Ltd., Gateshead-upon-Tyne, 4,000 incandescent lamps, £141 13s.

W. A. Platt & Son, Bury, covering new piping with magnesia covering.

Lancashire Dynamo and Motor Co., Ltd., enclosed motor.

**East Ham.**—The U.D.C. has placed an order, at £118 7s. 6d., with Messrs. Peirson & Co., to raise by 12 ft. the cooling tower at the electricity works.

**Exeter.**—The T.C. has accepted the tender of Messrs. Bruce Peebles & Co., for the supply of generating plant for the tramways at £1,050, with £166 for spare parts.

**Hackney.**—The B.C. has accepted the tender of the British Insulated and Helsby Cables, Ltd., for the supply of electricity mains, at £8,749 13s.

**Hammersmith.**—The B.C. has received the following tenders for high-pressure steam boilers:—

(*a*) COMBINED SUPERHEATER.

| Name. | Type. | Price. |
|---|---|---|
| Stirling Boiler Co. (English) | Water-tube | £3,800 |
| B. R. Rowland & Co. | Climax water-tube | 4,410 |
| Davey, Paxman & Co. (accepted) | Economic | 4,892 |
| Stirling Co. (U.S.A.) | Water-tube | 5,369 |
| Babcock & Wilcox, Ltd. | Marine water-tube | 5,445 |
| R. Hornsby & Son | Water-tube | 5,879 |
| Richardsons, Westgarth & Co. | Hornsby's type | 6,056 |
| R. Hornsby & Sons | Do. do. | 6,155 |
| Davey, Paxman & Co. | Economic | 6,286 |
| J. Fraser & Co. | Marine | 6,945 |
| Walther & Co. (German make) | Babcock & Wilcox | 7,500 |
| Clayton, Sons & Co. | Lancashire | 7,512 |
| Willans & Robinson | Niclausse | 8,173 |
| J. Thampson | Water-tube and Lancashire | 9,100 |

(*b*) SEPARATELY-FIRED SUPERHEATER.

| | | |
|---|---|---|
| Stirling Boiler Co. (English) | Water-tube | £4,253 |
| E. Danks & Co. | Economic | 4,967 |
| Do. do. | Cahall vertical water-tube | 5,020 |
| Stirling Boiler Co. (English) | Water-tube | 5,102 |
| B. R. Rowland & Co. | Climax vertical | 5,190 |
| Stirling Co. (U.S.A.) | Water-tube | 5,835 |
| Davey, Paxman & Co. | Economic | 5,563 |
| Stirling Co. (U.S.A.) | Water-tube | 6,119 |
| Lindsay Burnett & Co. | Economic | 8,833 |

(*c*) FITTED WITH MECHANICAL STOKERS.

| | | |
|---|---|---|
| Stirling Boiler Co. (English) | Water-tube | £3,898 |
| Babcock & Wilcox, Ltd. | Water-tube | 4,600 |
| B. R. Rowland & Co. | Climax vertical | 4,995 |
| Stirling Co. (U.S.A.) | Water-tube | 5,110 |
| R. Hornsby & Sons | Water-tube | 5,895 |
| Davey, Paxman & Co. | Economic | 5,518 |
| Richardsons, Westgarth & Co. | Hornsby's water-tube | 5,556 |
| Do. do. | Do. Do. | 5,911 |
| R. Hornsby & Son | Water-tube | 7,048 |

For overhead apparatus for removing ashes from the boiler house:—

Barry Transporter Co. (accepted), £190.

Bennis & Co., Ltd., £229.

(*Continued on page 183.*)

## THE WESTINGHOUSE UNIT-SWITCH SYSTEM OF MULTIPLE-UNIT TRAIN CONTROL.

It is now acknowledged by all classes of engineers that electricity offers the only satisfactory solution of the problem of the quicker working of city and suburban railway traffic, and there is no doubt that we are on the eve of a general, though necessarily gradual, conversion of local lines from steam to electric working.

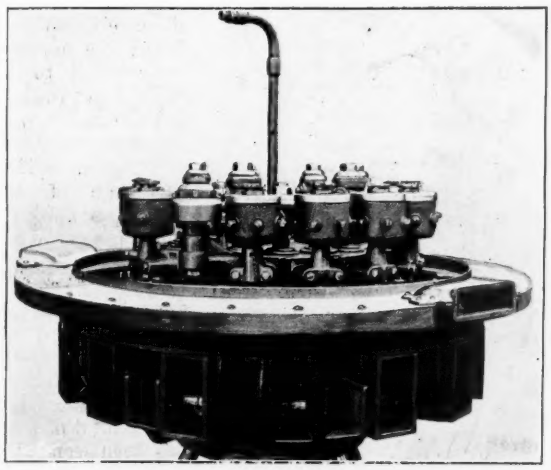


Fig. 1.—Westinghouse Turret Controller.

The chief reasons for this are two in number:—First, the possibility of quickly building or splitting up trains with one or more motor-cars combined with trailer or non-motor cars, just as the density of the traffic requires. Secondly, the high rate of acceleration which is obtained by having a number of pairs of driving wheels distributed along the length of the train.

One has only to consider the time occupied in getting up speed and in slowing down, say, on a run through a dozen city or suburban stations, in order to appreciate the vital importance of rapid acceleration and retardation. That rapid acceleration can be obtained much more easily when electricity is the motive power, than with any steam locomotive yet constructed, has been amply demonstrated, and the whole tendency of steam practice is in the direction of heavy trains at long intervals, whilst with electric traction a frequent service of light or heavy trains can be provided as required.

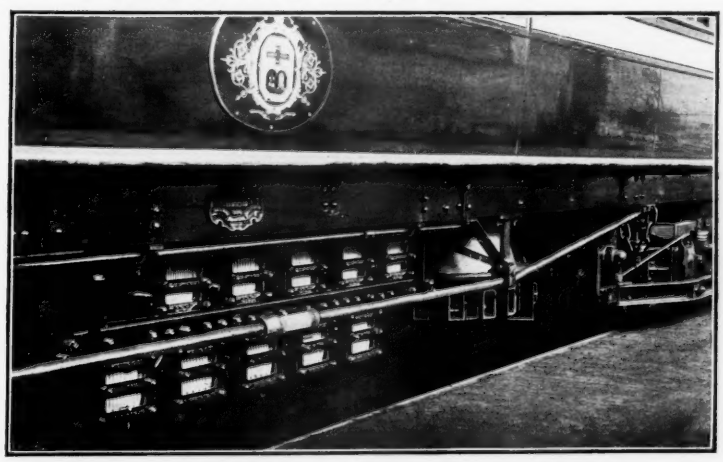


Fig. 2.—Position of Westinghouse Turret Controller on Underside of a Metropolitan Railway Car.

In this article we shall deal not so much with the multiple unit train as with the method of controlling the driving power, as exemplified in the Westinghouse multiple-unit train-control system, which is the result of several years' experience of electric railway work. As evidence that this system of electric train control fully meets the requirements of up-to-date practice, it is only necessary to mention that among the railways which have already adopted it are the following:—The Brooklyn Heights Railway, 314 sets of motors and controlling gear; the West Side Elevated Railway, of Chicago, 156 sets; the Metropolitan Railway, Paris, 102 sets; and the Metropolitan Railway, London. These contracts aggregate, together with the Mersey Railway, some 1,364 motors, with a total of nearly 210,000 H.P. The following descriptions and illustrations refer more particularly to the apparatus with which the cars of the Metropolitan Railway, of London, are being equipped.

For large and heavy cars requiring very powerful motors, the latest and best form of Westinghouse controller is the turret controller. This consists of a number of radially-grouped circuit-breakers or unit switches, which are closed by air pistons working against powerful springs which open the switch contacts when the air pressure is removed. Fig. 1 shows a turret controller with its cover removed, and fig. 2 illustrates its position on the underside of a motor coach. The 15 separate circuit-breakers or "unit switches" which are employed, are secured to a circular base, and are provided with a common magnetic blow-out coil at the centre. This single blow-out coil is a special feature, as it secures the ideal condition of maximum blow-out effect with minimum weight and space, and the number of parts and the amount of wiring necessary are very much reduced. Further, the use of a single coil enables it to be made of

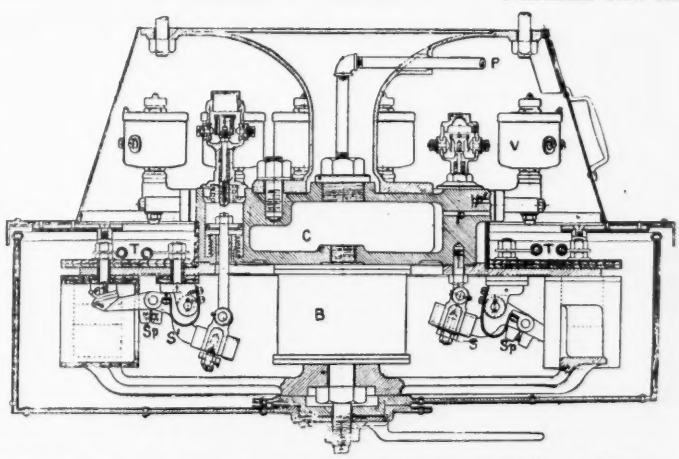



Fig. 3.—Westinghouse Turret Controller. Part Sectional View.

greater magnetic strength than could be the case if a number of smaller coils were used—one to each switch.

The air pistons actuating the radial switches work in vertical cylinders, and the air admission is controlled by needle valves operated by ironclad electro-magnets, which, together with the cylinders, project above the main base casting of the turret, as seen in fig. 1. A single pipe connection supplies compressed air to a central reservoir chamber, and ports around the latter admit air to the various magnetic valves, and thence to the cylinders, this construction reducing the amount of air piping and joints to a minimum.

A view of the turret controller, partly in section, is given in fig. 3. Here P is the compressed air supply pipe, C the air reservoir, $p$ the port leading to the magnetically operated valve V, and $p^1$ the port leading from the valve to the cylinder operating the switch S, which is shown in the open position. Another of the switches, $S^1$, is shown closed, and a section of the cylinder and piston operating it is given. B is the large blow-out coil, and two of the iron pole-pieces emanating therefrom may be seen to the right and left of the figure. These pole-pieces, which are more clearly shown in fig. 1, are U-shaped, and point alternately up and down; the top ones being bolted to the main iron casting, and the bottom ones to the extremities of a cast-iron spider. The core of the magnet is fixed to, and hangs down from, the main casting, and supports the spider, and also the attachment for the bottom cover. It may be mentioned that the general arrangement of parts has been somewhat modified since fig. 3 was drawn, but the latter is near enough for the purposes of a general description.

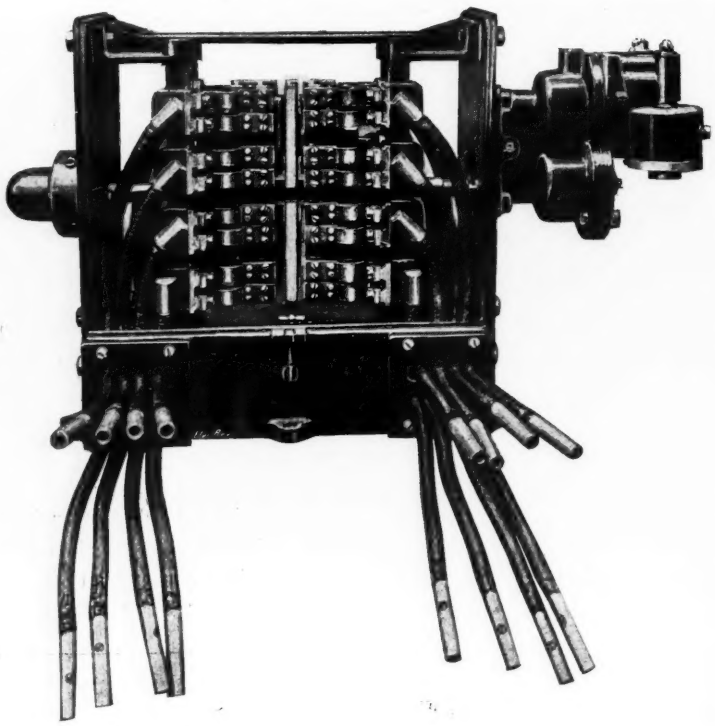


Fig. 4.—Interior of Pneumatically-operated Reversing Switch.

The contents of each switch are enclosed in a vulcabeston box or arc shield (fig. 1), and the magnetic lines from one top and one bottom pole pass through each such box, in a direction normal to that of the line of break of the switch, that is to say, horizontally. The strength of the blow-out field is such that test currents up to 18,000 amperes have been repeatedly and successfully broken, the burning at the switch contacts being negligible.

There is, of course, no limit to the length of break, or the power of cylinder that may be employed when switches are operated pneumatically. Each switch is closed by the action

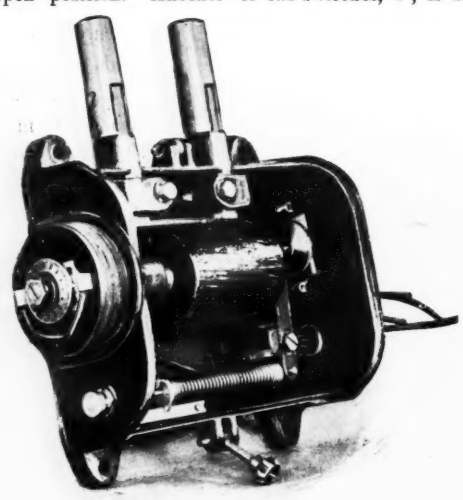


Fig. 4A.—Overload and No-Voltage Return Relay. (Case Open.)

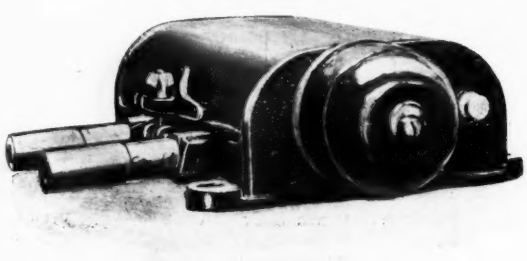


Fig. 4B.—Overload and No-Voltage Return Relay. (Case Closed.)

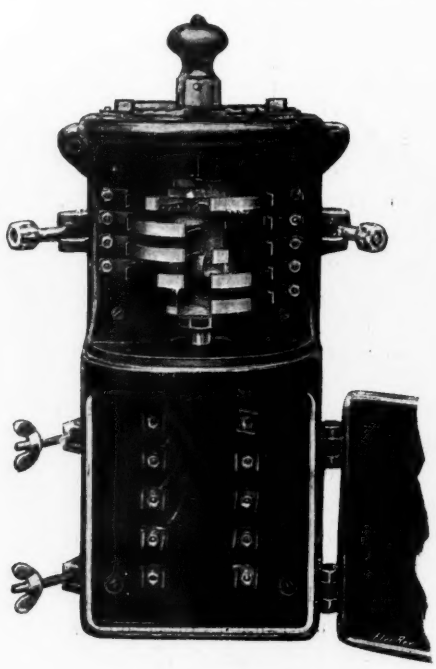


Fig. 5.—Master Controller.

of the air pressure in its cylinder, a powerful helical spring behind the piston being compressed at the same time. When the switch contacts are brought together, and also when they are separated, a spring in the moving arms comes into play and brings about a rolling and sliding motion of the contacts, and so keeps their surfaces in good condition and prevents all tendency to burn or weld. This spring is shown at *s p*, in fig. 3. Copper shunts are provided for all working pins and bushings in the switches; and the contact plates—which are easily renewable—are of ample area. When the exhaust port of the cylinder is opened, the spring under the piston drives the latter up and opens the switch. The switch terminals are shown at T T, in fig. 3, both these and the switch parts being insulated from the circular base-plate of the controller by sheets and bushings of vulcabeston. It is a good point that the terminals are on the opposite side of the base to the switches, the cables being thereby divided off from the latter. Another good point is that the low-pressure circuit terminals on the valve-magnets are well separated from the comparatively high-pressure switch terminals. The magnets and valves are enclosed by a hinged truncated cone-shaped cover, which can easily be removed, and the switches are enclosed by a revolving cover, the halves of which slide or telescope within each other.

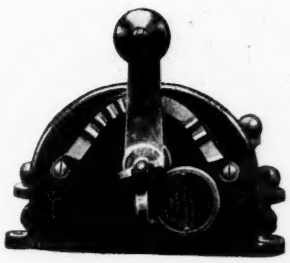


Fig. 6.—Head of Westinghouse Master Controller.

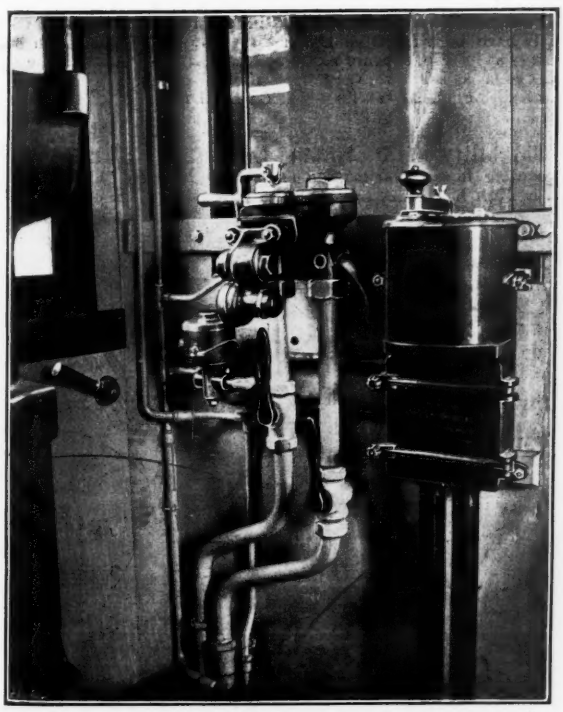


Fig. 7.—Westinghouse Master Controller (Unit-Switch System) Fitted in Driver's Compartment.

In addition to the turret controller, just described, a complete motor-coach equipment includes a reverser, an automatic excess-current and no-voltage return relay, one or more small master controllers, and a switchboard for the controlling of the car-lighting, compressor, and battery circuits, this switchboard being depicted in fig. 8. The reverser, which governs the direction of current through the motors, and, consequently, the direction of the motion of the car, is operated by an air motor, the admission of air being controlled by electro-magnetically operated valves similar to those on the turret controller, and it is of substantial and simple design. Fig. 4 shows its construction. The overload and no-voltage return relay, which is shown in figs. 4A and 4B, is connected with the operating magnet of one of the cylinders in the turret, this cylinder actuating the switch, which acts as main circuit-breaker. The no-voltage part of this relay, which is mounted on the end of the case, is of considerable importance, its function being to prevent the sudden restoration of full voltage to the motors, and consequent flashing thereat, after any unforeseen interruption in the supply of power, due to a break in the third-rail, something going wrong with the contact shoes, a momentary interruption of the supply to the line, &c. When this no-voltage device acts, it causes the controller to go back to a point with high resistance in circuit, the latter then gradually and automatically "notching out" the resistances as soon as the supply is resumed. It should be noted that the no-voltage action of the relay is not so instantaneous as to take notice of instantaneous interruptions due to the car contact shoe passing over points or crossings; and also that it does not act when the supply is suddenly cut off and then suddenly comes on again; hence the term *no-voltage return relay*.

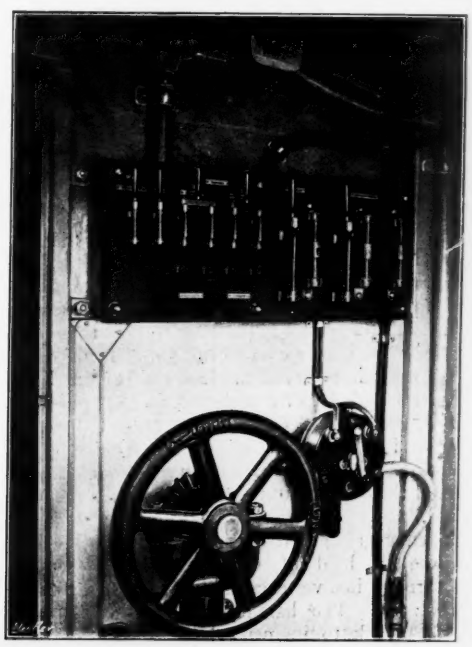


Fig. 8.—Switchboard for Car Lighting, Air Compressor, and Battery Circuits.

The connecting link between the electric and pneumatic gear and the human agent—the driver—now claims our attention. This—the master controller—is extremely compact, as will be seen by the foregoing illustrations. Fig. 5 shows it in elevation with its top and bottom casings opened; fig. 6 is a view of the head; fig. 7 shows it fitted up in the driver's cabin. The small size and light weight of the master controller, which is so called because it governs the operation of the turret controller, are due to the fact that the currents operating the valve-magnets of the latter are very small, and as they are derived from a low voltage (seven-cell) storage battery, there is no necessity for arc shields or blow-out coils.

The master controller has five notches for forward running and three for backward running, in addition to the neutral point. At the first "forward" notch, the emergency brake valve is set. At the second, the main supply circuit is closed and the reverse set. At the third—known as the

shunting notch—the motors are connected in series with all resistances in. At the fourth, an automatic acceleration device comes into action, and the controller goes on notching-up, provided it is not checked by the limit switch, till the eighth and last series notch is reached; the limit switch coming into play in order to maintain a uniform accelerating current. As the master controller drum is rotated, the pistons in the turret are actuated in due order, and the

Fig. 9.—Low Pressure Control Circuit Sockets and Plugs.

Fig. 10.—Low Pressure Circuit Connectors Coupled up.

corresponding switches are closed. When the master controller handle reaches its last notch, the turret switches which have already been put on are simultaneously opened, and a number of others simultaneously closed, these making the parallel connections for the motors. Then, subject to the action of the limit switch, the controller automatically notches up to full parallel, and the highest speed point is reached. It is of special importance to note that should the driver throw his handle over to full parallel at the start, the controller will still work automatically and gradually through all the series and parallel positions, so that no harm can come to the motors. A further advantage of this automatic acceleration is that it ensures the utmost economy in power consumption. Thus, with non-automatic control, it has been found that from 10 to 15 per cent. more energy is consumed.

An ingenious safeguard is provided in case the motorman should lose his hold of the controller handle through inadvertence, accident, or sudden illness. The handle, when released, flies back to its neutral position by spring action, and in so doing interrupts a circuit through the magnets shown above the air-pipe seen in fig. 7. The effect of this is to open a valve and allow the air in the main pipe of the air brake system to escape, with the result that the brakes are applied immediately throughout the train. When the brakes are not required to act, however, as in reversing, their above-mentioned automatic application may be prevented by passing the controller handle rapidly over the neutral notch. In running backwards, the operation of the controller is similar to its operation with forward running.

The motor-coaches that are being equipped for the Metropolitan Railway, London, will be fitted with four 150-H.P. motors—*i.e.*, 600 H.P. in all—and each coach will weigh approximately 39 tons. The full-length train will consist of two motor and four trailer coaches; and it will be possible to split it up into five, four, three, two, or single-coach trains as the density of the traffic decreases. The unusual power of these equipments is the reason for the large number of resistance steps in the controller, there being eight series and eight parallel positions. Nevertheless, the weight of the turret resistances, reverser, and pneumatic controlling gear is less than that of an ordinary electro-magnetic control equipment.

The cables are encased in asbestos slate mouldings, so that the fire-risk is practically negligible. Fig. 9 depicts the nine-way low-pressure controlling circuit sockets, and plugs, which constitute the only electrical connection between neighbouring cars; these are shown fitted together in fig. 10.

Fig. 11 gives side and end views of the collector gear for one car. The two outer beams are fixed one at each end of the car, and are provided with a positive collecting shoe at each extremity, and a negative shoe in the middle. The shorter middle beam is placed at the centre of the car length, and carries a negative or return current shoe only. The necessity for having collector shoes at each side of the car is explained by the fact that the conductor rail is sometimes on one side of the track and sometimes on the other.

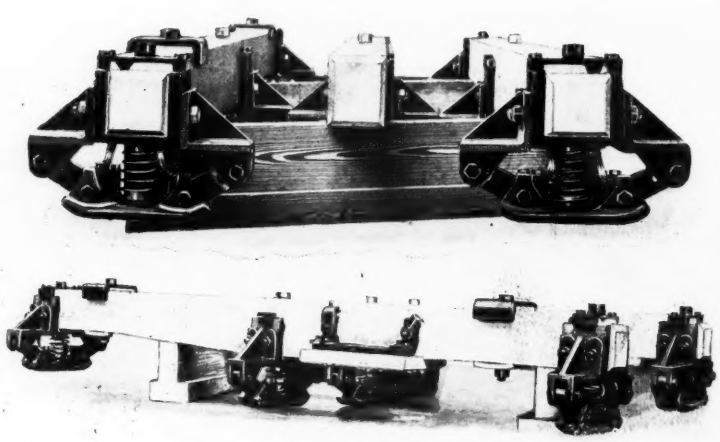


Fig. 11.—Current Collecting Gear.

**Electro-Chemistry in Italy.**—From a report upon the chemical industries of Italy, written by G. Elter, of Turin, in the *Chemiker Zeitung* lately, we are able to extract a few interesting details respecting the development of electro-chemistry and electro-metallurgy in that country. The greatest hopes have been based on these branches of industry for years, because of the large and numerous waterfalls which abound almost throughout Italy, and very much money has been spent in experiments. Capital is not lacking at the present time, but it is more difficult to raise for electro-chemical than for other chemical enterprises, a circumstance that is chiefly due to the failures of the past. The electrolytic manufacture of soda and bleach has been carried on in Italy for several years, but the results do not seem to be pecuniarily satisfactory, the chief reason for this being the unfavourable geographical situation of the factories, and the high price of salt. The electro-metallurgical industry is in a somewhat better position, two large works making calcium carbide, and one turning out barium hydroxide, as well as an electric furnace for the manufacture of steel, being in operation. The latter was erected to reduce the very rich and pure Italian iron ores on the spot by means of local water-power, but the capital raised with much trouble was exhausted before the end was achieved, and the highly-interesting results obtained would probably have been forgotten had not the Government carried them further at its own expense in the arsenal at Turin. At the present time, so far as is known, the process of electrical smelting is giving a satisfactory metal, at least when special qualities of steel are needed.

**Solubility of Platinum in Cyanide Solutions.**—According to a communication made to the Société Chimique de Paris, MM. A. Brochet and J. Petit find that platinum dissolves in notable quantities in alkali metal cyanides under the influence of an alternating current. Using a solution of potassium cyanide containing 4 gramme-molecules per litre, the dissolution exceeds 0·5 gramme per ampere-hour, when the current density is 40 amperes per sq. decimetre. This is equal to a loss of metal of 0·1 mm. thickness per hour. In some cases the platino-cyanides of the alkali and alkaline earth metals are produced, especially that of barium. The latter salt is obtained in two different forms, which are distinguished by their colour and by the strength of their fluorescence when exposed to X-rays and radio-active bodies.

## CONTRACTS CLOSED.

(*Continued from page 178.*)

**Fulham.**—The B.C. has accepted tenders for the following:—

100 3-ampere, 100 5-ampere, 75 10-ampere, 10 50-ampere and 5 100-ampere A.C.T. induction wattmeters, the British Thomson Houston Co., £591.
Steam exhaust and condenser pipes, Aiton & Co., £624.

**Hampstead.**—The B.C. has accepted the tender of the St. Helens Cable Co. for electric lighting cables for 12 months.

**Heckmondwike.**—The U.D.C. has placed an order for cable with Henley's Telegraph Works Co., Ltd.

**Lancaster.**—The T.C. on Wednesday accepted the tender of Messrs. Aiton & Co., at £229, for the new steam main connecting the old and the new boilers at the electricity works.

**London.**—The London County Council has received the following tenders for the supply of cranes and locomotives for the power station at Greenwich:—

1.—ELECTRIC JIB CRANES AND LOCOMOTIVES.

| | |
|---|---|
| Andrew Barclay, Sons & Co., Kilmarnock (incomplete) | £1,178 |
| Henry J. Coles, Derby (incomplete) | 3,652 |
| C. and A. Musker (1901), Ltd., Liverpool, No. 1 | 4,078 |
| Ditto. Ditto. No. 2 (accepted) | 4,108 |
| John Hitchen & Son, Halifax | 4,880 |
| Joseph Booth & Bros., Rodley (incomplete) | 4,924 |
| Thomas Smith & Sons, Rodley, Leeds (incomplete) | 5,178 |
| Wimshurst Hollick & Co., Rochford, Essex | 5,248 |
| Cowans, Sheldon & Co., Carlisle | 5,264 |
| James Carrick & Sons, Edinburgh | 5,334 |
| Ransomes & Rapier, Ltd., London | 5,878 |
| George Russell & Co., Motherwell | 5,619 |
| Jessop & Appleby Bros., Leicester | 6,628 |
| Rushworth Bros., Colne, Lancs. | 7,185 |

2.—OVERHEAD TRAVELLING CRANES, &c.

| | |
|---|---|
| Herbert Morris and Bastert, Loughborough (incomplete) | £937 |
| C. and A. Musker (1901), Ltd., Liverpool (accepted) | 1,192 |
| Cowans, Sheldon & Co., Ltd., Carlisle | 1,541 |
| James Carrick & Sons, Ltd., Edinburgh | 1,557 |
| Carrick & Ritchie, Edinburgh | 1,712 |
| Joseph Booth and Bros., Ltd., Rodley | 1,740 |
| Jessop & Appleby Bros. (not to specification) | 1,766 |
| John M. Henderson & Co., Aberdeen | 2,025 |
| Holt & Willetts, Cradley Heath (incomplete) | 2,352 |
| Wimshurst, Hollick & Co., Ltd., Rochford | 2,651 |

**The successful contractors are authorised to sub-let portions of the work embodied in the orders.**

**London.**—The Metropolitan Asylums Board received the following tenders on Saturday:—

For installation of fire alarms at Darenth Asylum:—

| | |
|---|---|
| P. Dewhirst, Blackpool (accepted) | £320 5 |
| Sillem, Donnison & Co. | 400 0 |
| Jackson Bros., Plaistow | 403 10 |
| Electrical Engineering and Maintenance Co. | 420 0 |
| National Telephone Co., Ltd. | 440 10 |
| Baxter & Impey, Birmingham | 459 0 |
| Lea, Son & Co., Shrewsbury | 497 0 |
| H. G. Rider & Co., London | 500 0 |
| Lever Bros. & Co., Fulham | 600 0 |
| Mason, Cash & Co., Burton-on-Trent | 673 0 |
| Private Wire and Telephone Installation Co., Ltd., Westminster | 797 10 |
| Laurences, Ltd., London | 1,650 0 |

It was reported that the estimate of the engineer-in-chief was £380.

For installation of telephones at Eastern and Western Hospitals:—

| | |
|---|---|
| P. Dewhirst, Blackpool (accepted) | £359 10 |
| Baxter & Impey, Birmingham | 437 0 |
| Robert Weston, Kingsland | 440 0 |
| Sillem, Donnison & Co. | 450 0 |
| British Home and Office Telephone Co. | 459 18 |
| Electrical Engineering and Maintenance Co. | 494 0 |
| National Telephone Co., Ltd. | 506 0 |
| Lea, Son & Co. | 521 0 |
| The Private Telephone Co. | 529 10 |
| E. Probert & Co. | 579 15 |
| Private Wire and Telephone Installation Co., Ltd. | 609 19 |
| Laurences, Ltd. | 655 10 |
| Ward Bros. | 740 0 |
| G. and H. Turner, Harlesden, N.W. | 795 18 |
| Jackson Bros., Plaistow, E. | 876 5 |
| Mason, Cash & Co., Burton-on-Trent | 996 0 |
| C. Barrington, Stoke Newington, N. | 1,182 10 |
| Lever Bros. & Co., Fulham | 1,200 0 |

It was reported that the estimate of the engineer-in-chief was £580.

For annual supplies of electrical accessories, the tenders of the following were accepted:—

Armorduct Manufacturing Co. (8 items).
Baxter & Caunter, 86, Charing Cross Road, W.C. (2 items).
Berliner Telephone Manufacturing Co. (3 items).
Craigpark Electric Cable Co., Ltd. (3 items).
Dewhurst's Engineering Co., Ltd., Sheffield (4 items).
Edison & Swan United Electric Light Co. (4 items).
Electrical Co., Ltd. (2 items).
General Electric Co. (14 items).
E. Goossens, Pope & Co. (3 items).
H. Greene & Co. (2 items).
India-Rubber, Gutta-Percha, Telegraph Works Co., Ltd. (1 item).
Laurences, Ltd. (4 items).
London Electrical Fittings Co., Ltd., Hampstead Road, N.W. (4 items).
A. P. Lundberg (2 items).
Pryke & Palmer (14 items).
Siemens Bros. & Co., Ltd. (1 item).
Siemens Electric Appliances, Ltd. (1 item).
Sun Electrical Co., Ltd. (1 item).
J. H. Tucker & Co., Birmingham (4 items).
Veritys, Ltd. (11 items).

**Loughborough.**—The T.C. has accepted the tender of Messrs. E. Green & Son, Ltd., for an economiser, at £402 10s., and that of Messrs. T. Sugden, Ltd., for two superheaters, at £142 10s. each.

**Macclesfield.**—Messrs. D. Firth & Son have secured the contract for the installation of the electric light at the Macclesfield Asylum.

**The New War Office.**—The order for the electric lighting of the new War Office has been placed with Messrs. F. A. Glover & Co., Ltd.

**Radcliffe.**—The U.D.C. has accepted the tender of Messrs. Etheridge & Clark, of Manchester, for the laying of the permanent way of the tramways.

**Salford.**—The following tenders have been accepted by the T.C.:—

Russell & Sons, Ltd., Wednesbury, sectional B poles, at £5 15s. each, and C poles, at £7 12s. 6d. per pole.
F. Smith & Co., Salford, 15 drums of 1,050 yards each of S.W.G. trolley wire, 7·375d. per lb.
Hall & Pickles, iron and steel (tramways).
Giddings & Dacre, Ltd., glass (tramways).
Isaac Bentley & Co., Ltd., paints, oils, &c. (tramways).
Brilliant Shino Metal Polish Co., metal polish (tramways).
W. T. Glover, Ltd., lead piping.
R. W. Blackwell & Co., Ltd., pull offs, strains, car accessories.
Docker Bros., Ltd., special paints, varnishes, &c. (tramways).
L. Andrew & Co., car accessories (electrical).
Miller & Co., Ltd., 80 in. diameter chilled cast-iron wheels.
Giddings & Dacre, Ltd., wire, solder, lead, tin, &c. (tramways).
J. J. Rigby, Ltd. oil for Well's lights (tramways).
Brecknell, Munro & Rogers, Ltd., car accessories (mechanical).
Geo. Hill & Co., switches, section boxes, &c.
Commercial Electric Co. and Liverpool Electric Cable Co., Ltd., car accessories (electrical).
Johnson & Phillips, rubber-covered cables.
National Rail and Tramway Appliances Co., Ltd., accessories (mechanical).
Messrs. Estler Bros., car accessories (electrical).

**Stepney.**—The B.C. has received the following tenders for supply of cable during the period ending December 31st, 1906:—

| | |
|---|---|
| W. T. Henley's Telegraph Works Co., Ltd. (accepted) | £11,007 10 |
| Callender's Cable & Construction Co., Ltd. | 11,235 10 |
| Siemens Bros. & Co., Ltd. | 11,293 0 |
| British Insulated & Helsby Cables, Ltd. | 11,302 0 |
| W. T. Glover & Co., Ltd. | 11,389 0 |
| Western Electric Co. (informal) | — |

ELECTRICALLY-DRIVEN CRANE.

| | |
|---|---|
| Jessop & Appleby Bros., Ltd., Leicester (accepted) | £508 0 |
| T. Smith & Sons, Radley | 525 10 |
| Chatteris Engineering Works Co | 587 0 |
| Crompton & Co., Ltd. | 601 0 |

SUPPLY AND ERECTION OF MOTOR-DRIVEN BOOSTERS.

| | |
|---|---|
| Bruce Peebles & Co., Ltd. (accepted) | £526 |
| General Electric Co., Ltd. | 540 |
| British Thomson-Houston Co., Ltd. | 551 |
| Mather & Platt, Manchester | 570 |

**St. Pancras.**—The B.C. has received the following tenders for a low-pressure switchboard at the King's Road station:—

| | |
|---|---|
| T. W. Broadbent | £728 0 |
| Ferranti, Ltd. | 900 0 |
| J. G. Statter & Co. | 1,026 0 |
| British Westinghouse Co., Ltd. (accepted) | 1,035 7 |
| Johnson & Phillips | 1,059 0 |
| Northcote, Heaver & Co. | 1,088 0 |
| Electrical Co., Ltd. | 1,095 0 |
| Cowans, Ltd. | 1,109 0 |
| British Thomson-Houston Co., Ltd. | 1,121 18 |
| Bertram Thomas, Ltd. | 1,188 0 |
| Kelvin & James White, Ltd. | 1,170 10 |
| Nalder Bros. & Thompson, Ltd. | 1,215 0 |
| Consolidated Electrical Co. | 1,220 0 |
| Westminster Engineering Co. | 1,230 0 |
| Veritys, Ltd. | 1,249 0 |
| E. F. Moy, Ltd. | 1,260 0 |
| Siemens Bros. & Co., Ltd. | 1,270 0 |
| Elliott Bros. | 1,296 0 |
| Edison & Swan United Electric Light Co. | 1,834 0 |
| Electric Construction Co., Ltd. | 1,357 0 |
| Aberdeen Electrical Engineering Co. | 1,490 0 |
| Electric & Ordnance Accessories Co. | 1,560 0 |
| Dorman & Smith | 1,638 0 |
| John Fowler & Co. | 1,665 0 |
| Crompton & Co., Ltd. | 1,965 0 |

**Topsham.**—The tender of Messrs. Edwards & Armstrong, of Bristol, for the plant and mains for the electric light installation, has been accepted by the Electricity Supply Co.

## NOTES.

**Belgian Government and Home Industries.**—According to *Le Soir*, of 24th inst., the Belgian Government has taken an active part in furthering the reconstruction of the Société Electricité et Hydraulique, of Charleroi, which was accomplished on the 7th inst., the name of the company becoming La Société anon. des Ateliers de constructions électriques de Charleroi. The Government has promised to facilitate the erection of large central power stations for the supply of energy to towns, railways, &c., and for a beginning has authorised the installation of a large works at Brussels to supply the whole of the Government establishments, railway stations, &c., within a radius of 25 kilometres. The com-

pany's works are to be equipped with machinery for the manufacture of cables, incandescent lamps, and other electrical accessories, and being practically subsidised by the Government, the future prospects of the undertaking are bright.

**Motors v. Electric Tramways.**—At the sitting of the Engineers and Surveyors' Section of the Sanitary Congress at Glasgow, on Tuesday, Mr. E. Shrapnell-Smith, secretary and treasurer of the Automobile Mutual Protection Association, and a member of the Council of the Liverpool Self-Propelled Traffic Association, read a paper on "Motor Vehicles in Relation to Municipal Service," in which he strongly advocated the employment of motor vehicles for municipal engineers and officials, to aid them in their work. Touching on the question of motor omnibuses, he said the first consideration was that compared with electric traction on rails by the trolley system, a service of motor 'buses necessitates one-sixth of the capital expenditure. Æsthetic views may also carry weight at times, for some towns resent the laying of rails and the use of overhead wires. The largest experience has been gained at Eastbourne. The greatest expense has invariably been in replacing rubber tires, which are essential to comfort for passenger service. This item has reached 8d. per car-mile—in some cases—but improvements in manufacture, and in the methods of securing the tire to the rim, have now reduced this by three-fourths. The cost per car-mile, inclusive of depôt expenses, repairs, depreciation, driver, stores, sundries, and supervision, will vary from 8d. to 9d. for a 16-passenger 'bus, and will be under 1s. for a double-decker, where a sufficient number of 'buses are run to reduce the incidence of management. The increase in width to 7 ft. 6 in., and the higher speed of 12 miles an hour, which are permissible under the new regulations, render the prospects of the motor omnibus particularly attractive both for complete services and for feeder purposes. Where the traffic stops are numerous, as in London, a hydraulic variable speed gear, with an infinity of ratios between the extremes instead of the usual three or four steps, is of value with the internal combustion engine, which is in greater vogue than steam for this work.

Mr. Strange (Eastbourne) said the motor service in that town was highly appreciated by the inhabitants, the only difficulty being that, owing to their having to start in too great a hurry, they had not sufficient 'buses. Although they had had many difficulties, the first six months showed a profit of £67.

Mr. Councillor Beach (Eastbourne) said the great benefit to Eastbourne of the adoption of the motor system was that it had kept away the electric tramways.

Mr. Mawbey (Leicester) said that if they took a large town like Leicester, where they had to carry their population three or four times over in a week, it was obvious that electric tramways were the only means of giving such facilities. It might be all very well at a seaside town, but he felt that the time had not come when they could adopt motors in preference to electric tramways in large towns.

Mr. Smith, in reply, said he did not intend to convey the view that motor-omnibuses were of universal application, and he agreed that in large towns electric tramways worked from a central generating station would be able to compete with motor-omnibuses. In the case of towns like Eastbourne, however, there was a great deal to be said in favour of motor-omnibuses.

**London County Council.**—At the meeting of the Council on Tuesday, the Finance Committee reminded the meeting of the recent decision to advance on loan to the Marylebone Borough Council the sum of £1,415,000 on or before October 1st, 1904, on terms and conditions to be subsequently determined. The Committee now stated that it proposed, and the Borough Council had agreed, to pay as interest the actual cost to the County Council of raising the loan when the money was provided by the special issue of London County Bills contemplated for that purpose, and that on the issue of stock for the permanent loan, interest should be calculated in the manner usually adopted when the interest on loans to local authorities was determined after each issue of stock, the general principle being that the County Council should be fully protected against any loss on the transaction. The Borough Council was anxious to take up the loan early in October, and the Finance Committee, therefore, suggested that it should be authorised to invite, open and accept tenders for county bills not exceeding in the aggregate £1,500,000, with a currency of not less than three nor more than twelve months, in order to provide the necessary funds for the purpose. The Committee submitted a recommendation, which the Council adopted in the sense indicated.

The Council also decided, on the recommendation of the Finance Committee, to sanction the borrowing by the Marylebone Borough Council of £433,800 for the erection of a generating station, and the provision of machinery and plant; to advance £9,958 to the Shoreditch Council for electric lighting works and the purchase of meters; and to lend £10,000 to the Woolwich Council for plant, machinery and mains.

An expenditure of £33,500 was authorised for the erection and equipment of a sub-station, to be built in connection with the power station at Greenwich. The Highways Committee asked for authority to expend £4,960 on the provision of roof covers for sixty electric cars.

**The London Traffic Commission.**—The Royal Commission on London Traffic has appointed Mr. Stephen Sellon, of Westminster, "to make a report upon the tramway undertakings in the principal cities and towns of the United Kingdom, and investigate the traffic and operative results obtained in connection therewith, and the conditions in regard to tramway transportation existing in such cities and towns as compared with London."

**The British Association Meeting at Cambridge.**—The following are some of the papers which are to be read before Engineering Section G:—

Thursday, August 18th.—Address by the Hon. C. A. Parsons, President of the Section.
Lecture by Mrs. Ayrton, "The Origin of Sand Ripples."
Friday, August 19th.—Mr. C. Dugald Clerk, "The Internal Combustion Motor in Britain."
Prof. B. Hopkinson, "Some Tests on Small Gas Engines."
To be followed by a general discussion.
Monday, August 22nd.—Mr. C. H. Merz, "The Use of Electricity on the North-Eastern Railway and on Tyneside."
Mr. A. A. C. Swinton, "Electricity from Water-Power."
Mr. W. M. Mordey and Mr. A. G. Hansard, "Energy Losses in Magnetising Iron."
Prof. J. A. Fleming, "Large Bulb Incandescent Lamps as Secondary Standards of Light."
Tuesday, August 23rd.—Major Sir Hanbury Brown, K.C.M.G., "The Control of the Nile."
Mr. J. H. Wicksteed, "A Universal Testing Machine of 300 tons for Full-sized Members of Structures."
Mr. S. Cowper-Coles, "A New Process for Applying Zinc to Metallic Surfaces."
Mr. J. W. Hayward, "The Effects of Receiver Drop in a Compound Engine."

**The Fiscal Question.**—In discussing the suggestions made by the Tariff Commission in favour of the imposition of import duties on iron and steel, the Berlin *Tageblatt* states that the scheme naturally only represents proposals, but that it can scarcely be doubted that they will be realised in some form or other. If the signs of the times are accurately interpreted, it may be asserted that the English iron and steel duties will arrive quicker than many people in Germany anticipate. Many of the experts in the German iron and steel industry have flattered themselves with the hope that they would arrest the advance of English protectionist plans by the projected conclusion of international agreements for the limitation of spheres of interest. The report of the Tariff Commission, the Berlin journal observes, shows, however, that these hopes have proved to be illusory.

**Fires at Electric Lighting Works.**—It appears from the recently issued volume of "London Statistics," for 1903-4, which was compiled by the London County Council, that four fires occurred at electric lighting works in London during the year; three of them were due to defective circuits, the cause of the fourth being unknown. Two electricians' premises suffered by fire, and six electrical engineers' premises were attacked. In no case was more than slight damage done. During the year there were no fewer than 1,036 fires at private houses, and whereas only one of these was caused by a defective electric circuit, 51 were due to escapes of gas, and 68 to the upsetting of mineral oil lamps.

**An Up-to-Date Electrically-Equipped Dock.**—In order to successfully keep pace with the times, it is essential that everything connected with the handling of our enormous sea-borne trade should be on a scale commensurate with its value and importance. This is especially so with regard to the equipment of docks. The progress made in the economical handling of the goods and mineral traffic at many docks has been very marked, and the once stereotyped hydraulic crane has generally been superseded by the electrically-driven crane with its greater flexibility, higher speed, and greater economy. Several modern docks in America and on the Continent are electrically-equipped throughout. In the former country progress has been most marked in connection with the handling of minerals on the shores of the great Lakes; while our Continental friends have developed remarkably successful dock equipments for handling the miscellaneous cargoes which are dealt with at their ports. In this country a good many docks are partly equipped with electric power, but it has been left to the Clyde Navigation Trustees to initiate the biggest electric dock scheme in this country, or, indeed, anywhere, and the progress of their new dock, now in course of construction at Clydebank, will be watched with great interest by electrical engineers, and by all interested in the development of our shipping trade. The equipment will be up to, and in several respects ahead of, current practice. There will be a large number of jib cranes constructed specially for high speed, while the railway wagons will be moved rapidly in and out of the range of these cranes by electric capstans. By far the most important feature will, however, be the huge coaling hoists. These will be arranged for dealing with coal wagons up to a gross load of 32 tons at a high rate of speed, and will therefore be quite up to the capacity of modern mineral wagons. They will be interesting from an engineering, as well as a general point of view, being the first of such hoists to be operated electrically. It is hoped that the first portion of the dock will be opened about February, 1905, and the whole scheme, when completed, will form one of the finest examples of a modern dock equipment. We understand that Mr. Walter Dixon, M.I.E.E., of Messrs. Walter Dixon & Co., electric power engineers, Glasgow, who has devoted many years to this branch, and has inspected the principal dock equipments in the United States, in this country, and on the Continent, has been retained by the Clyde Navigation Trustees as their engineering expert.

**Electricity in Mines.**—In his annual report to the Home Office, Mr. Henry Hall, H.M. Inspector of Mines for the Liverpool and North Wales district, refers to the extended use of electricity in mining as follows:—"During the year an exhaustive inquiry has been held by a committee of experts, with the object of framing regulations to govern the use of electricity in and about mines. This source of power is making rapid progress and extension for hauling, pumping, and coal cutting, and it is its adaptation to the last-named work which will have to be carefully watched and its dangers adequately guarded. With the ordinary motor for coal cutting a good deal of sparking takes place when the machine meets

with unequal resistances—for instance, when the cutting tools come in contact with hard substances, such as iron pyrites; and these sparks would, no doubt, ignite firedamp if it happened to be present. It has been suggested that the motor itself should be so enclosed by an outside covering that any sparking or ignitions of explosive atmosphere taking place within such box or covering could not pass out or communicate with the outside atmosphere; a second suggestion is that the current employed should be multiphase. I am afraid there will be great difficulty in keeping a motor sufficiently cool to allow of its doing its work properly when it is so closely boxed in as has been suggested."

**South African Notes.**—*Johannesburg.*—A boy, named Lazarus, climbed an electric light pole belonging to one of the mines at Boksburg to release his kite, which was entangled in the wires. He received a fatal shock.

*Durban.*—The T.C. agreed to the following report of its Electric Light and Traction Committee:—"On the acting borough electrical engineer's report, dated June 18th, 1904, with reference to the desirability of considering the question of additional traction engine plant for the power station, by reason of the increasing consumption of current and demand for power; at present, 76 motors, aggregating about 800 H.P., are supplied from the traction engines, and motors to the extent of 102½ H.P. are now applied for. Taking advantage of the borough electrical engineer's presence in England, the Committee decided to at once cable Mr. Roberts of the present conditions, authorising him to obtain prices and particulars for another large set of engines for consideration on his return."

**Appointments Vacant.**—Lecturer in physics for the Birmingham Municipal Technical School (£140); Chief assistant electrical engineer for Weymouth and Melcombe Regis (£120).

## OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

**Central Station Engineers.**—Mr. R. V. WEARE, lately shift engineer to the Bournemouth Corporation and Ilford District Council, has been appointed to a similar position at the works of the Brompton and Kensington Electric Supply Co., Ltd.

The salary of the borough electrical engineer at Hornsey has been increased from £300 to £340, and by £30 per annum for the next two years.

Mr. E. E. GARRARD, of Great Yarmouth Corporation Electricity Works, has been appointed to the post of charge engineer at the North Metropolitan Electric Power Supply Co.'s new power station at Brimsdown.

**Electric Tramway Officials.**—Mr. J. BOWDEN, rolling stock superintendent to the London United Tramways, is proposed by the Highways Committee for a similar position in connection with the London County Council tramways, the salary being £400 per annum. The other two gentlemen in the final list were Mr. A. A. BLACKBURN, car-shed superintendent to the Manchester Corporation Tramways, and Mr. J. H. F. BALE, rolling stock superintendent, on the Mersey Railway, for the British Westinghouse Co. There were 129 applications for the position.

**General.**—The Council of the City and Guilds of London Institute has awarded the Siemens Medal and premium (Electrical Engineering) to Mr. H. W. PURLE, and the Siemens Medal (Civil and Mechanical Engineering) to Mr. H. D. CREEDY. Both gentlemen were matriculated third year students of the Central Technical College. The Diploma has been awarded to 21 students in Electrical Engineering, 36 in Civil and Mechanical Engineering, and four in Chemistry, all of whom have completed a full course of instruction.

On the 18th inst., at St. John's Church, Huddersfield, JOHN HEWETT, B.A., M.Inst.E.E., eldest son of Lt.-Col. Hewett, R.M.A., ret., of Cheltenham, was married to Beatrice, daughter of the late Ben Lockwood, of Storthes Hall, Kirkburton, Yorkshire, and Mrs. Lockwood, of Birkby, Huddersfield.

On Saturday last the officials of the Engineering Department of the Mersey Railway met at the "Old Post Office Hotel," Birkenhead, to present Mr. M. F. WALSH with a case of cutlery, on the occasion of his retiring from the position of chief clerk to that department. The presentation was made in a few appropriate words by Mr. H. A. FLEET, station superintendent, to which Mr. Walsh suitably responded.

## NEW COMPANIES REGISTERED.

**Electrical Bleaching Co. (1904), Ltd.** (81,614).—This company was registered on July 20th, with a capital of £75,000, in £1 shares, to adopt (5) agreements, one with the Electrical Bleaching Co., Ltd., three with C. E. W. Gaddum and one with J. J. Graham, and to carry on the business of bleachers, dyers, dressers, finishers, makers of vitriol and bleaching materials, manufacturing chemists and druggists, wholesale or retail dealers in textile fabrics, spinners, weavers, and manufacturers of and dealers in wool, cotton, silk, flax, hemp, jute and other fibrous substances, electricians, electrical engineers, suppliers of electricity, &c. The first subscribers are:—C. E. W. Gaddum, Cleveland, Bowden, cotton manufacturer and dyer, with 100 shares; G. Worthington, 15, Minshull Street, Manchester, cotton manufacturer, with 100 shares; W. H. Marriott, Balne Mills, Wakefield, worsted spinner and dyer, with 100 shares; F. H. Allen, Delaheys House, Hale, gentleman, with 100 shares; G. St. John Day, Mumps Electrical Works, Oldham, electrical engineer, with 100 shares; E. L. Thorpe, 18, Clipstone Avenue, Nottingham, electrical engineer, with 100 shares; and H. Wood, 196, Deansgate, Manchester, manufacturer, with 1 share. Minimum cash subscription, 15,000 shares. The number of directors is not to be less than two nor more than seven; the first are C. E. W. Gaddum, G. Worthington, W. H. Marriott, F. H. Allen, G. St. John Day and E. L. Thorpe; qualification, 100 shares; remuneration (except managing director), £150 each per annum. Registered office, 196, Deansgate, Manchester.

**Arnold Goodwin & Son, Ltd.** (81,633.)—This company was registered on July 22nd, with a capital of £10,000 in £1 shares, to manufacture, construct, equip, improve, administer, sell, repair, manage, or control railways, tramways, trolleyways, mills, factories, warehouses, works, and other premises in England or elsewhere, and to carry on the business of railway proprietors, manufacturers of rails, sleepers, cables and the like, electricians, electrical, mechanical, and general engineers, producers and distributors of electricity, steam, hydraulic, air and other power, gas, water, and electrical fitters, rubber manufacturers and merchants, &c., and to adopt an agreement with A. Goodwin. The first subscribers (each with one share) are:—A. Goodwin, 56, Sumner Street, Southwark, engineer; H. Clarkson, 9, Ironmonger Lane, E.C., solicitor; A. G. Clarkson, 9, Ironmonger Lane, E.C., solicitor; A. M. Newcombe, Grace House, Beckenham, auctioneer; H. B. Knight, 111, Birkbeck Road, Beckenham, clerk; M. E. Brown, 129, Birkbeck Road, Beckenham, clerk; and S. C. Cain, 17, Chaffinch Road, Beckenham, clerk. Minimum cash subscription, 100 shares. A. Goodwin is the permanent governing director. Remuneration as fixed by the company. Registered office, 56 and 58, Sumner Street, Southwark, S.E.

**Davies, Kent & Stewart, Ltd.** (81,627).—This company was registered on July 21st, with a capital of £3,500 in £1 shares (2,500 preference), to acquire the business carried on at 17, Berners Street, W., as Davies, Kent, and Stewart, to adopt an agreement between G. A. G. Davies, H. W. Kent, and B. G. Stewart, of the first part, Mary A. E. Stewart, of the second part, Catherine T. Kent, of the third part, and this company, of the fourth part, and to carry on the business of manufacturers of electrical accessories, flexible wire makers, electricians, suppliers of electricity, &c. The first subscribers (each with one share) are:—G. A. G. Davies, 17, Berners Street, W., electrical engineer; H. W. Kent, 17, Berners Street, W., electrical engineer; B. G. Stewart, 17, Berners Street, W., electrical engineer; L. H. Lewis, 49, Godelphin Road, W., electrical engineer; Gertrude M. Kerry, 32, Gladstone Avenue, East Ham, typist; Mrs. M. A. E. Stewart, 40, Upper Richmond Road, East Putney, S.W.; and H. P. Parrott, 499, York Road, Wandsworth, licensed victualler. No initial public issue. Registered without articles of association.

## ELECTRICITY SUPPLY ACCOUNTS.

### West Bromwich Municipal Electricity Supply.

THE returns of the third year's working of this undertaking are of a very satisfactory character. The output, thanks to traction developments, has been quadrupled and the revenue more than trebled. Working costs have fallen to nearly 1d. per unit and the progress is represented financially by a gross profit of £4,218 as compared with some £771 on the previous year. The department meets all financial charges and carries a balance of £1,546 towards the formation of a reserve fund.

The prices charged are:—Private lighting, 4½d. and 1½d. per unit, maximum demand; power, 1d., and traction, 2d. per unit. The chief engineer is Mr. J. H. Wray.

GENERAL STATEMENT.

| For year ending March 31st— | 1904. | 1903. |
|---|---|---|
| Total capital expended ... ... ... | £56,506 | £41,897 |
| Number of units sold— | | |
| Private supply ... ... ... ... | 271,096 | 178,308 |
| Public lighting... ... ... ... | 42,557 | 1,593 |
| Traction (by contract) . ... ... | 791,353 | 105,947 |
| Total number of units sold ... | 1,105,006 | 285,848 |
| Equivalent No. of 8-C.P. lamps connected | 12,065 | 11,938 |
| H.P. of motors connected ... ... ... | 163-H.P. | 140-H.P. |
| Number of public lamps ... ... ... | 80 | 1 |
| Maximum load in KW. ... ... ... | 788 | 568 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £9,318 | £2,930 |
| „ expenditure ... ... ... | £5,100 | £2,159 |
| „ profit ... ... ... ... | £4,218 | £771 |
| Average inclusive price obtained per unit— | | |
| Private lighting ... ... ... | 2·35d. | 2·46d. |
| Public lighting... ... ... ... | ·91d. | |
| Traction ... ... ... ... | 1·98d. | |

REVENUE ACCOUNT FOR YEAR ENDING MARCH 31ST, 1904.

| | | |
|---|---|---|
| Gross revenue ... ... ... ... | £9,318 = | 2·20d. per unit. |
| Works and distribution costs ... ... | £3,891 = | ·84d. „ |
| Total working costs ... ... ... | £5,100 = | 1·11d. „ |

PROFIT STATEMENT.

| | |
|---|---|
| Interest on loans ... ... ... ... ... | £1,474 |
| Sinking fund ... ... ... ... ... ... | 1,198 |
| Balance carried forward ... ... ... ... | 1,546 |
| Gross profit ... ... | £4,218 |

### Oldham Municipal Electricity Supply.

THE Oldham returns do not disclose a very promising situation, doubtless due in great part to the disturbed state of local industry. While the output has gone up, the receipts have declined—this being due to decreased charges for energy made to the tramways department. The private and public supplies are both progressing slowly, and the working costs are an improvement on the previous year. It is in meeting the financial charges which have nearly doubled since last year, that the effect of the adverse conditions of the past year becomes apparent, the deficit of £771 being, under the circumstances, a small one.

The prices charged are:—For private lighting, 4d. to 1½d., sliding scale, and 4d. and 1½d., maximum demand; power, 2d. to 1½d.; trams, 1½d.; and public lighting, 2½d. per unit. The engineer is Mr. S. Wilmott Newington.

GENERAL STATEMENT.

| For year ending March 25th— | 1904. | 1903. |
|---|---|---|
| Total capital expended ... ... ... | £242,974 | £216,882 |
| Number of units sold— | | |
| Private supply ... ... ... ... | 848 095 | 762,213 |
| Public lighting ... ... ... ... | 17,362 | 16,972 |
| Traction ... ... ... ... ... | 2,177,309 | 2,090 127 |
| Total number of units sold ... | 3,042,766 | 2,869,312 |
| Equivalent No. of 8-c.p. lamps connected... | 58,207 | 54,154 |
| Load factor ... ... ... ... ... | 19·6 % | 21·6 % |
| Maximum load in KW. ... ... ... | 1,765 | 1,743 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £25,974 | £26,279 |
| „ expenditure ... ... ... | £13,303 | £13,667 |
| „ profit ... ... ... ... | £12,671 | £12,612 |
| Average inclusive price obtained per unit— | | |
| Private supply ... ... ... ... | 3·4d. | 3·5d. |
| Public supply ... ... ... ... | 2·5d. | 2·5d. |
| Traction ... ... ... ... ... | 1·5d. | 1·69d. |

REVENUE ACCOUNT FOR YEAR ENDING MARCH 25TH, 1904.

| | | |
|---|---|---|
| Gross revenue ... ... ... ... | £25 974 = | 2·60d. per unit. |
| Works and distribution costs ... ... | £10,387 = | ·82d. „ |
| Total working costs (less tax returned) | £13,303 = | 1·05d. „ |

PROFIT STATEMENT.

| | |
|---|---|
| Interest on loans (less tax returned) ... ... | £7,361 |
| Sinking fund... ... ... ... ... | 6,081 |
| Deficit on year's working ... ... ... ... | — 771 |
| Gross profit ... | £12,671 |

## CITY NOTES.

**The Haste Pump.**

A PROSPECTUS of the Haste Pump Co., Ltd., is before the public, offering 80,000 £1 shares for subscription. The company, which has a nominal capital of £100,000, is formed for the purpose of acquiring and working a number of pump patents granted to C. W. Milne and F. C. Haste. The company is mentioned in the prospectus as the parent company, as it is expected that considerable profit will be made by the sale and working of foreign patents, and the granting of licences, in addition to that to be derived from manufacturing operations. The pumps are being used by the City of London Electric Lighting Co., the Sheffield electricity department, and certain electrical and other engineering firms. The purchase price "for the invention and patent rights," &c., is £60,000, payable either entirely in ordinary shares, or partly in cash and partly in shares, at the option of the directors. The first £40,000 subscribed will be available for working capital. Several of the directors are directly connected with the electrical industry—C. Williamson Milne, J. M. Hewitt, F. Barnes Spencer.

But little actual manufacturing work appears to have been done under the patents up to the present, for we read that "an expenditure of nearly £7,000 has been incurred by the vendors in taking out patents and in establishing the nucleus of a manufacturing business." It can hardly be anticipated that the profits on *manufacturing* can be sufficient to earn "substantial dividends" on £80,000 capital at a particularly early date, so we must suppose that it is from the sale of patents, and the granting of licences that the chief portion of the anticipated profit is to be derived. We note that the chairman of the company, Mr. C. Williamson Milne, is to receive £41,500 as his share of the purchase price. We can quite believe that business men will be somewhat chary of investing money in the company without knowing what has been the rate of profit on the business that has already been done. It is pointed out in the prospectus that "no charge has been made for goodwill," but £60,000 seems to us an excessive figure for the patents of a pump. Even if paid for entirely in shares, the holders of the remaining £40,000 would have this £60,000 to reckon with when looking for dividends, but if we understand the prospectus correctly, the *option* to pay the vendors partly in cash, is quite likely to be exercised after £40,000 has been subscribed for working capital. This belief may, to some minds, be strengthened by the circumstance that the chairman of the company is himself a vendor.

### General Electric Co.

THE ordinary general meeting of this company was held on Wednesday at the offices of the company, 71, Queen Victoria Street, E.C., Mr. G. Byng presiding.

In moving the adoption of the report and balance-sheet, the CHAIRMAN said that he would give a few words in explanation of the figures. The headings were almost identical with the heading given three years ago, so that a comparison was easy. The year they were dealing with had been a most difficult one, as the home trade had been exceedingly quiet, more especially the building trade, upon which the electrical industries largely depended. The company had maintained their turnover; in some departments they had increased it, but they had had to spend more money in doing so, and prices ruling lower, they could hardly expect to do better than in previous years. The results shown in their balance-sheet must, therefore, be considered satisfactory. The amount for depreciation written off that year exceeded by £3,000 that allowed for the previous year; their property account was larger, and adequate depreciation in works was an essential to good finance of a manufacturing concern. The income from investments was less than last year, yet they would find that their investments had increased by £12,000. Most of that increase was due to the foundation of their own houses in South Africa—a return upon which could not be shown that year, but would be shown next year. They believed that all their investments were sound. They were mostly composed of shares in sub-companies, such as the Robertson Lamp Works, the Steel Tubing Works at Birmingham, the British General Electric Co. in South Africa, and the Uxbridge Electric Supply Co. Their capital account had increased by the addition of ordinary shares, thus forming further guarantee for the preference shareholders. Sundry creditors showed an increase of about £20,000, but a great many of the contracts included in that had since been liquidated. On the credit side of the balance-sheet they would find the figures almost identical with those of last year. They did not extend their buildings last year, and therefore the increase of their property account was small. The increase in sundry debtors and stock-in-trade was the natural outcome of a progressive business, and was in some measure due to the fact that they had raised four sub-branches to the status of independent branches, which entailed the keeping of larger stock, and the giving of larger credit. As to their reserve account, they had raised it to £80,000, and hoped that next year their reserve would cover the items of goodwill and patents, standing at £92,000. Having put aside to reserve the average amount of £20,000 during the last four years, there remained a surplus which would enable them to propose a dividend of 7 per cent. on the ordinary shares. Although that was an improvement on the previous year, it could hardly be considered a grand return. It was evident, however, that that dividend could be earned by the company in bad times, and they must look forward to a more adequate return in those good times which he hoped would return. With regard to the progress in the works, and the outlook for the future, he said that their oldest works, the Peel Works at Manchester, continued to be full with orders; the various departments, such as electrical supplies, switchboards, instruments, arc lamps, bells, &c., were working all the year round at high pressure. The telephone department had considerably benefited by the requirements of the Government. In order to prepare for the anticipated increase in orders, they had decided to pull down a number of adjoining cottages belonging to the company, in order to extend their Manchester works. The fixture works in Birmingham also continued to be fully employed, and the Witton Engineering Works had undergone a particularly pleasant change during the year, and they found that they could produce there as cheap and as good machinery as could be produced anywhere in the world. They had succeeded in securing a most gratifying number of orders which had enabled them to complete their standard patterns and designs for actual contracts, instead of laying down speculative lines. Those orders included important contracts for mines in Westralia, South Africa, and also in England. They had secured contracts for generating plants of sizes from 100 to 1,500 KW. for important towns such as Hastings, Reigate, Hornsey, Bedford, Handsworth, Aston Manor and Dublin, and they had also secured important orders for dynamos and motors from the War Office and the Admiralty, and for Colonial railway companies. One of the most satisfactory orders had been the contract for 340 motors for the lifts for the underground electric railways of London. The fact that the company had been the pioneer of polyphase work in this country had assisted them considerably in their mining work, and it was only fair to state that they had not found any difficulty in getting both the intellectual and the manual labour required for such intricate work in this country. They noticed particularly among the younger generation of engineers a desire to keep their theoretical knowledge on a par with their practical experience. The position of the carbon works belonging to the company was one which had aroused, and was arousing, much public interest. They had worked throughout the year by day and night shifts so that they could cope with the orders they had received for English made carbons, which had come mainly from the Government and large public bodies. The directors were satisfied that they had quashed the mistaken idea that that article could not be produced in this country. The quality they were producing was admittedly equal to the best foreign makes, but he was sorry to say that the unfair competition—which practically had as its object to make them close down their works—had not enabled them to make both ends meet, and they had again been obliged to write off a considerable sum for running those works. They had, however, no hesitation in stating that they were prepared to continue to do so, as they felt they would eventually succeed, and that those works would become as successful a branch of their business as their other factories had developed into. In conclusion, the Chairman laid before the meeting his views on the subject of Protection so far as it affected the company. It was a matter of vital importance to a company like theirs, which had invested in their works a sum exceeding £1,000,000

sterling, and which employed over 5,000 hands. He had been told that the company had done well under Free Trade, and it was true, and even under the adverse circumstances of free import the company *had* been enabled to earn an adequate return on its capital, but their company was not affected so much as many others by the fiscal policy of the country. They had large financial resources, a goodwill of a quarter of a century, and experience and a management well versed in the tendencies of international trade, and those factors had enabled them to withstand the attacks of foreign competition while others had gone to the wall. People had asked him, "Why are you not satisfied with such results?" Well, if he were so short-sighted as they were, he would probably be satisfied, but he was not, and consequently he was not satisfied. He never would be satisfied to see the prosperity of that great firm rest upon the failure of competitors who could not withstand the attacks of foreign competition. The prosperity of the firm must rest upon the prosperity of the country. Their opponents of Protection had told him that all he wanted Protection for was in order to make larger profits, and manufacturers were supposed to desire to gain at the expense of the many consumers. He would say that that was a false statement, and was put forth by men who were entirely ignorant of the modern conditions of industry. The prices which were obtained by foreign manufacturers in this country were on the average high prices; but would the English manufacturer be quite content with such prices? No, he would not. What they wanted was more orders and more security in their home and Colonial markets; a security which would enable them to know who their competitors were, which would enable them to calculate their costs and their chances and risks upon equal terms with their foreign competitors. They wanted to increase their output, and, by increasing their output, to reduce the cost of production. If they had such security, they would be able to pay higher wages as well as reduce the cost of production. Speaking of the electrical industry, of which he knew every detail, he would say that he did not believe that the users of electricity would have to pay any higher prices than they were paying now; on the contrary, if they continued free imports, the user would have to pay increasing prices, because the competition of the home manufacturer would grow less and less. He could submit proofs of that contention, which would show that, in many instances, foreigners were obtaining enormous profits through lack of English competition, and that home competition under Protection would be so great that it would be impossible for any manufacturer to take more than his ordinary legitimate share of profit. The cry that Protection would increase the price of manufactured articles certainly did not apply to the electrical industry. There could not be the slightest doubt that Protection would come, and the directors of the General Electric Co. were acting on that conviction at the present moment.

Two of the shareholders present expressed disapprobation of the chairman's final remarks, one of the gentlemen objecting to "a chairman airing extremely crude views upon economic questions at a company meeting." "Was it to be understood that the policy of the company would fail if we did not have Protection?"

The CHAIRMAN replied that the policy of the company was at present based on the supposition that Protection would come. If it did not come within five years, they would have to discharge hundreds and thousands of workmen. He thought that the question was one that ought to be ventilated at a shareholders' meeting.

After further discussion, the motion for the adoption of the report was seconded by MR. H. HIRST, and carried.

## Eastern Telegraph Co.

THE half-yearly meeting of the shareholders of this company was held on the 22nd inst. at River Plate House, Finsbury Circus, Sir John Wolfe Barry, K.C.B., presiding.

The CHAIRMAN, in proposing the adoption of the report, said that the gross revenue for the half-year under review amounted to £626,750, or an increase of £9,134. The revenue for the current half-year, however, included an amount of £15,440 for interest on investments in respect of reserve funds, which was credited to the reserve fund in March, 1903. If, therefore, for the sake of comparison, that interest were deducted, the gross revenue for the half-year showed a decrease of £6,306, when compared with that of the half-year ended March 31st, 1903. The receipts derived from the traffic with South Africa showed a considerable decrease, as well as those from traffic with China, Japan, and the Philippines. The diminution of receipts from the latter source was mainly due to the important reduction of rates which came into force in July last year, and also to the fact that the New American Pacific Cable Co. was carrying the bulk of the American traffic with those places. The European traffic continued to pass exclusively by the Associated Co.'s route. The Indian traffic showed an increase, and the traffic with Egypt also showed a considerable improvement, but the latter would probably be of a temporary nature, the increase having, to a large extent, been due to the prolonged cotton crisis. The total expenses for the half-year showed an increase of £17,763, when compared with the corresponding period of 1903. The principal items of increase occurred under the following heads:—General expenses in London, £2,710; general expenses at the stations, £5,968; and expenses attending maintenance of cables, £5,375. The increase in the expenses at stations was accounted for by the annual promotions, and an increase of 68 in the number of the staff, which, during 1904, had had to deal with about 1,000,000 more words than in the corresponding six months. The increase in the volume of traffic had been due to a general development of business, the exceptional conditions caused by warlike expeditions, and the cotton crisis, and also to the important reductions in the rates which had been brought into force from time to time during recent years. The increase under the heading of maintenance of cables was the result of that account only having received a credit of £46,293 from other companies on accounts for repairs to and renewals of cables during the current half-year, as against £60,364 in the corresponding period—a reduction of £14,071. As a set-off against that, however, the value of cable used and sundry expenses showed a decrease of £8,401. The result of the half-year's working was that, after providing the usual debenture and preference interest, they were able to recommend the usual final dividend of 1½ per cent., and a bonus of 2 per cent., making with the interim dividends already paid a total distribution of 7 per cent. for the year, and to carry £170,000 to the general reserve fund against £180,000 last year. They had also repaid £100,000 to the Eastern and South African Co.; and a similar sum had been applied from the general reserve fund in reduction of the cost of the cables laid in connection with the new route to South Africa and Australia. They had also applied from reserve fund the sum of £135,859 on account of the partial renewal of the original Aden-Bombay cable laid in 1870, and £23,206 on account of the partial renewal of the Suakin-Perim No. 2 cable laid in 1876. Their old ss. *Chiltern* had been sold out of the service. She was built in 1866, and acquired by the British Indian Telegraph Co. in 1870, and taken over from that company at the amalgamation in 1872. During those 34 years she had carried out a very great number of repairs, and had proved a most valuable ship for the work she had to do. They had reduced the maintenance ships fund by £31,800, being the difference between the cost and the amount realised by the sale of the vessel. Included in the capital expenditure for the half-year was the cost of a small cable-repairing vessel suitable for work in comparatively shallow water. It was anticipated that a saving would be effected by using a vessel of that type for certain minor repairs, instead of, in every case, employing the company's larger and more expensive ships. Although he did not propose to say anything with regard to the old question of the Government Pacific cable competition, the grievance still remained, and continued to adversely affect their revenue. They were, of course, meeting that unfair Government competition by the best means available, viz., by consistently continuing their old policy of constantly endeavouring to improve the speed and accuracy of their service by the application of the latest form of apparatus, and granting additional facilities to the telegraphing public, with due regard to the interests of their stockholders. A policy of that kind must necessarily tend to increase expenses, but they were perfectly satisfied that it was a sound policy, calculated to maintain their present revenues, and, he hoped, also to augment them in the future. With regard to wireless telegraphy, they, no doubt, had seen that the De Forest system had been successful in carrying war correspondents' messages from ship to shore during the present Russo-Japanese war. While holding the view that wireless telegraphy would not compete with long-distance submarine telegraphy, there were certain places where wireless telegraphy could be usefully employed. They had a case in point in the Azores, where the cables of some of the Associated Co.'s touched. It was desired by Portugal that some of the outlying islands should be placed in telegraphic communication. Owing to the nature of the bottom, and the landing place of those islands, it was not considered a suitable place to make the connection by cable; neither would the traffic warrant an expenditure on that account. They, therefore, intended to connect the points by a system of wireless telegraphy, to be worked in connection with their cable system.

Sir J. DENISON PENDER, K.C.M.G., seconded the motion, and the report was adopted.

## National Telephone Co.

THE thirty-fourth ordinary general meeting of this company was held on 22nd inst. at Hamilton House, Victoria Embankment, E.C., Sir Henry Fowler in the chair.

In moving the adoption of the report, the CHAIRMAN said that so far as the past half-year was concerned, as contrasted with previous half-years ending June 30th, he thought the directors and shareholders had reason to congratulate themselves, seeing that the half-year was a record, and when he came to deal with the details of the accounts, he thought they would concur in that opinion. He had explained on more occasions than one that the report presented for the June half-year was in the nature of an interim report. They could not accurately review the entire position of the company, except at the end of the year. So far as the half-year which had just expired was concerned, the income which had accrued in respect of the business of that half-year amounted to £984,600, as compared with £894,583 for the corresponding period of 1903, being an increase of £90,016. The working expenses for the half-year amounted to £567,001, as compared with £509,414, showing an increase of £57,657. The net result for the half-year, after deducting Post Office royalties amounting to £90,702, was a profit balance of £326,825, as compared with £303,156 for the corresponding period. That was an increase of net income, after some exceptional items of expenditure had been dealt with, of £23,668. The rentals carried forward for unexpired terms of running contracts amounted to £937,296, as compared with £874,383 carried forward in the corresponding half-year, being an increase of £62,913. The available balance for dividend was £258,286, and they proposed to transfer £100,000 to the reserve fund, and to carry forward a balance of

£9,369. Their capital expenditure during the half year amounted to £394,654. There were one or two remarks he wished to make on those figures. The first was with regard to the capital account, which, as they knew, had been increased during the half-year by the issue of £1,000,000 of debenture stock, which was now fully paid up. The expenses had increased all round, in all the principal items. That was natural. Their rates had increased, their insurance had been heavier, and their increase in business meant an increase in the number of their operators and in all other working expenses. He thought he was right in saying that they had added to their staff nearly 1,000 new operators during the half-year. The increase in the number of their stations—which was, perhaps, one of the very best indexes of progress made during the last half-year—had been a record increase, the increase in the six months having amounted to 19,615, which was represented in the income to which he had called their attention. They had spent an unusually large sum that last half-year for maintenance and replacements, replacements being, as they knew, a charge which was made for a portion of a certain class of capital expenditure, of which one-third was fairly chargeable to revenue. Their shareholders remained pretty stationary in number; last December they had 10,250, and to-day they had 10,355. The average holding of the shareholders was £531, so that they had a large constituency of shareholders holding on an average a very small sum indeed in the concern. Their debenture stockholders had increased owing to the new issue of debenture stock; last December their number was 3,400, and they now numbered 4,400. Another feature was that of their unexecuted orders, and he could only repeat what he said last February that those unexecuted orders were mainly owing to their want of capital to execute them. Last year they had 9,232 people who were wanting to be put on, but whose orders were unexecuted; and in that half-year, although they had put on the great bulk of that 9,000 odd, they had still 9,700 who were waiting to be put on, which represented a rental which, if earned, would be over £53,000 a year. Their number of telephone messages during the last year was 938,000,000, and the average receipt per message was ·41d., or less than ½d. Under the circumstances he thought he could congratulate the shareholders on a good half-year. There was one subject, however, on which he would say a few words, and as to which he was in a position of difficulty. He referred to the negotiations with the Postmaster-General. Under the company's license the Postmaster-General, by giving notice to the company on or before June 30th last, was empowered to acquire compulsorily the company's undertaking as from December 31st next, the purchase price, in case of difference, being determined by arbitration. That notice had not been given, and consequently, the Postmaster-General's compulsory rights had ceased. The Postmaster-General had intimated his desire to come to an arrangement with the company by agreement, and negotiations with that object were in active progress. He need hardly tell them that they involved intricate investigations, and that many difficult questions had to be considered which could not be hurriedly determined. He believed that the Postmaster-General would credit the board of directors with a desire to meet him in a fair spirit, and all he could say was that he hoped the negotiations would result in a satisfactory arrangement being arrived at which would enable that great public service to be adequately and properly developed, and which would, at the same time, be equitable and fair to the shareholders. Having said that much, he asked them to have confidence in the directors, and to leave the negotiations in their hands.

Mr. George Franklin, vice-president, seconded the motion.

Mr. Hughes, a shareholder, asked whether the charge of £100,000 for discount and commission for obtaining £1,000,000 debenture stock was not rather excessive.

The Chairman said that the stock was issued at 95, and considering the state of the money market, the directors thought that a very satisfactory issue for a 4 per cent. stock.

Mr. Lea Smith congratulated the board on the report. He considered that the telephone was in its infancy, and that the public did not thoroughly appreciate what they got for their money. The motion was then carried. The retiring directors, Sir James Fergusson, Bart., M.P., Mr. Samuel Herrick Sands, and Sir James Thomas Woodhouse, M.P., were then re-elected. A vote of thanks to the chairman concluded the proceedings.

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**Central London Railway Co.**—The report for the half-year ended June 30th states that the receipts from all sources of revenue amounted to £184,961, and the working expenses to £95,125, leaving a balance of £89,836. During the half-year to June 30th last, there has been a decrease of 209,741 passengers (or less than 1 per cent.) in the number carried. The average receipt per passenger is 1·86d. After providing for debenture interest and other payments, the net revenue account shows a balance of £108,737, including £36,078 brought forward. The directors recommend dividends on the undivided ordinary and the preferred ordinary stock at the rate of 4 per cent. per annum for the half-year.

**Dublin United Tramways Co. (1896).**—The report for the half-year ended June 30th, states that the amount available for division is £44,153, out of which it is recommended that a dividend be paid for the half-year at the rate of 6 per cent. per annum on the ordinary shares.

**Westminster Electric Supply Corporation.**—The directors have declared an interim dividend for the half-year ending June 30th at the rate of 13 per cent. per annum.

## Edmundson's Electricity Corporation.

Mr. F. E. Gripper, M.I.E.E., presided on Thursday last week at the Westminster Palace Hotel over the seventh annual meeting of the above company.

In moving the adoption of the report, he said they would have seen that Mr. J. R. Wigham had been obliged, through failing health, to relinquish his duties as chairman and director of the company. Mr. Wigham had been at the head of the undertaking for a great number of years, having been the senior partner of the private firm, and then chairman of the private company, which were the forerunners of the company, and it was with the greatest regret that they had had to accept his resignation. The directors had done him the honour of electing him their chairman in his place—a position which it would be his endeavour to fill to the best of his ability. They had been fortunate in securing the services of Mr. H. Wolfenden to fill the vacant directorship. He was glad to be able to report the continued satisfactory progress of the company's business. Established seven years ago for the purpose of working a considerable number of electric lighting undertakings, they were now reaching the end of what he might term their construction stage. The seven years had been occupied, first of all, in acquiring the various powers and concessions which they now possessed; and, secondly, in carrying out the necessary works and establishing their business in the numerous towns for which they had obtained powers. The work done during these early years in establishing nearly 40 electrical undertakings, spread all over the kingdom, had been very heavy, and the expenditure of capital had been very heavy, too; and it was with much satisfaction that the directors felt that they were now approaching the time when not only would the work be less onerous, and the expenditure of capital much reduced, but they should begin to see good results of their work. Since the last meeting they had completed electric lighting works at Caterham, Glossop, Berwick, Ryde, Surbiton, Frome, and Dorking, and had completed and opened electric tramways at Glossop and Scarborough. At Newbury, the lighting works were almost completed, and would be opened in a few weeks. Good progress had been made in connection with the Lancashire electric power station, and it was expected it would be opened early next year. With the exception of two towns, they would then have the whole of their works opened and running. The two exceptions were Ramsgate and Inverness, for which—after many attempts—they had recently obtained the necessary Parliamentary powers. It was not the intention of the directors to seek for further powers, except such as might be necessary for their existing undertakings, as they would have ample scope in the development of the undertakings which they were now interested in. The rapid expansion of the various undertakings was shown by the lamp connections which, during the year, increased from 335,000 to 568,000, and had since increased by another 65,000 connected or applied for during the past three months. During the past year the issue of new capital had been necessarily heavy to meet the expenditure on the new works already mentioned, and the extensions required in the older works; and 20,000 preference shares, 20,000 ordinary shares, and £92,000 of debenture stock had been issued. The necessity for raising so much new capital at a time when market conditions had been unfavourable for all issues had given the directors much cause for careful consideration, and he thought they might congratulate themselves in having obtained this capital on reasonable terms. Their capital requirements for the future—for the reasons he had already explained—would be on a less extensive scale. Turning to the balance-sheet, they would see that the result of the year's trading was a net profit of £39,640 16s. 8d., which was about £13,000 more than last year. In addition to this, they had received £16,914 17s. as interest and dividends on their investments, which was about £3,000 more than last year. Realisation of investments had brought them in a profit of £5,058 10s. 5d., principally derived from the completion of the sale of their Woolwich undertaking. Last year they had a profit of £14,785 from this source. The total profits, including transfer fees received, amounted to £63,698 10s. 7d. as against £56,924 last year. This was an increase of about £7,000. Including the balance of £11,733 6s. 4d. brought forward from last year's account, the total amount to be dealt with this year was £75,431 16s. 11d. Interest on the debenture stock and upon temporary loans had absorbed £11,025 18s. 8d. Dividends upon the preference shares has required £15,544 12s. 8d., and the interim dividend paid on the ordinary shares acounted to £8,750, leaving £40,111 5s. 7d. now to be appropriated. The directors recommended that a further sum of £5,000 be written off the goodwill account, that £5,437 14s. 4d. be carried to the reserve fund, and that a final dividend at the rate of 9 per cent. be paid for the half-year upon the ordinary shares. This would make the total dividend on the ordinary shares 7 per cent. for the whole year, the same as last year, and would leave £13,923 11s. 3d. to be carried forward to the next account. He had already dealt with the amount of new capital which had been issued during the year. Premiums amounting to £24,562 5s. 8d. had been received in respect of these issues, and this amount had been added to the reserve fund, which, with the amount they were now asked to carry to this fund from the profits, would increase the reserve from £40,000 to £70,000. Looking at the other side of the balance-sheet, they would find that sundry debtors stood at the large figure of £305,000, as against only £75,000 last year, but this amount included a sum of £200,000 which was owing to them by the Urban Electric Supply Co., the whole of which had now either been paid, or would very shortly be paid off. The amount of their investments in subsidiary companies, taken at par value, amounted to £957,982 16s. 6d., and particulars of the various items were given in the schedule which accompanied the report. The amount of reserve against these investments had been increased this year by £45,000, making a total

of £165,384 14s. 1d. With the £70,000 in their reserve fund, they had now a total of over £235,000, which was a 25 per cent. reserve against the realisation at par of their investments, and as they had every reason to anticipate that as their various investments were realised, they could get at least their par value, the shareholders would agree, he hoped, that their financial position was a satisfactory one.

Mr. W. R. Davies seconded the motion, and after some complimentary remarks by Mr. Paxton and Mr. A. Bailey, M.P., the report was adopted.

## Anglo-American Telegraph Co.

The report of the directors to be presented to the half-yearly meeting of the proprietors, at 2 o'clock to-day, shows that the total receipts from January 1st to June 30th, 1904, including the balance of £1,268 11s. 4d. brought forward from the last account, amounted to £165,614 8s. 1d. The traffic receipts show a decrease of £13,280 as compared with the half-year ended June 30th, 1903. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £63,578 15s. 8d., being a decrease of £2,314 7s. 2d. as compared with the corresponding period of 1903. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £90,035 12s. 5d. Quarterly interim dividends of 12s. 6d. per cent. on the ordinary stock, and of £1 5s. per cent. on the preferred stock, was paid on April 30th, 1904, absorbing £43,750, and second quarterly interim dividends of 12s. 6d. per cent. on the ordinary stock, and £1 5s. per cent. on the preferred stock, amounting to £43,750, will be paid on July 30th, 1904. The balance of £2,535 12s. 5d. will be carried forward to the next account. All the main cables and landlines of the company are in good working order. A scheme of pensions for employés of the company, in lieu of the present system of endowment assurance, has been prepared by the directors, and will be submitted to the stockholders for their approval.

## City and South London Railway Co.

The directors' report for the half-year ending June 30th, 1904, which was presented at the meeting held yesterday at Finsbury Pavement, E.C., says that the receipts from all sources for the half-year amounted to £80,204, and the cost of working had been £36,569, leaving a profit of £43,634. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £44,404. After making provision for the debenture stock interest, and the transfer to the renewal fund of £1,500, a balance remains available for dividend of £31,685. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891, 1896 and 1901, and that a dividend at the rate of 2½ per cent. per annum be paid upon the consolidated ordinary stock for the half-year, leaving a balance of £701 9s. 11d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders:—

| Half-year ended. | No. of passengers (exclusive of season ticket holders). | Receipts (including season tickets). | Dividend per cent. per annum on ordinary stock. |
|---|---|---|---|
| December 31st, 1901 .. .. | 7,008,842 | £59,734 14 8 | 2¼ |
| June 30th, 1902 .. .. | 9,192,120 | 76,843 12 3 | 3 |
| December 31st, 1902 .. | 9,877,199 | 82,131 7 1 | 3⅜ |
| June 30th, 1903 .. .. | 9,511,450 | 78,384 19 9 | 2¾ |
| December 31st, 1903 .. | 8,711,062 | 72,286 3 6 | 2 |
| June 30th, 1904 .. .. | 9,226,987 | 76,387 14 1 | 2¼ |
| Total since opening of line | 126,307,268 | £1,004,912 2 1 | |

Railway opened for traffic December 18th, 1890.
Extension to Moorgate opened February 25th, 1900.
Extension to Clapham Common opened June 3rd, 1900.
Extension to Islington opened November 17th, 1901.

There is a slight diminution in the dividend, as compared with the corresponding period last year, but, considering the competition of the electric tramways and the continuance of fine weather, the directors are satisfied that the general traffic of the line is showing a steady improvement. Negotiations with the railway companies and other public bodies with whom agreements have to be made in respect of the extension to King's Cross, St. Pancras, and Euston, have made considerable progress, but are not yet sufficiently advanced to allow a contract to be entered into for the construction of the line. It is, however, hoped that these negotiations will be brought to a conclusion at an early date, and authority will, therefore, be asked for the creation and issue, when required, of the capital necessary to carry out the extension, the interest on which will not be a charge on the revenue of the company until the line is open for traffic. The works of the Baker Street and Waterloo Railway are making rapid progress, and the plans of the low level subway at the Elephant and Castle connecting the platforms of the two stations have been agreed. The Great Northern and City Railway was opened in February last, and the interchange traffic with that railway is steadily progressing.

## Baker Street and Waterloo Railway Co.

The half-yearly general meeting of the shareholders of this company was held on Wednesday at Hamilton House, Victoria Embankment, Mr. T. J. Hare presiding.

The Chairman, in proposing the adoption of the report, said there was nothing in the capital account to which he need refer. Steady progress was being made with the works. On the section between Waterloo and Melcombe Place all the tunnelling had been done. The detailed work at the stations both above and below ground was progressing. On the Elephant and Castle extension only 960 lineal yards of the main tunnel remained to be driven. One tunnel was now right through from close by the Elephant and Castle station to the Marylebone station of the Great Central Railway. Possession of all land on that extension had been obtained, except at the southern terminus, and the contractors would be put in possession of that site shortly. At the depôt site the siding tunnel had been completed, and there only remained about 187 lineal yds. of the branch line tunnel to be driven. The excavations and retaining walls were well advanced, and the ground was being cleared for the construction of the carriage sheds, &c. On the extension of the company's line west of Baker Street, possession had been obtained of the land for stations at Edgware Road, and at Lisson Grove adjoining the Great Central terminus. The Edgware Road site had been cleared, and the lift shafts were about to be commenced. The up-running tunnel had reached Lisson Grove, and the shield to enable the down-running tunnel to be proceeded with was in course of erection, and would be finished shortly. Generally, the works all through the line were being pushed on as rapidly as possible. At the last meeting he referred to the Board of Trade requirements in regard to the precautions to be taken against the risk of accident by fire on underground electric railways. Those requirements had now been finally settled, and the risk of accident from fire on underground railways might, he thought, now be considered quite infinitesimal. Their Bill which was opposed by the L.C.C. in both Houses, thereby causing much unnecessary expense, had passed the Committees of Parliament, and received the Royal assent on Friday last. The object of the Bill, as they were aware, was to empower the company to build stations at Westminster Bridge Road and Regent's Park, and to purchase extra land, also to authorise the necessary capital to pay for those and other improvements not contemplated at the time the original construction contracts were made. The Royal Commission on London Traffic, after sitting for 60 days, and holding a most exhaustive inquiry, had now ceased hearing evidence, and would, doubtless, in due course, issue its report. The most important thing they would like to know, was when the line was likely to be opened. It would be some time next year, but it was impossible to say when.

Sir Algernon West seconded the motion, and the report was adopted.

## British Continental Electricity Co.

The directors' report for the year ended April 30th, 1904, says that during the year 48 new installations have been connected, and 1,622 8-c.p. lamps have been added. The receipts from sale of current show an increase of £257 over those of the preceding year, while the working expenses have been reduced, hence the profit from the year's trading is considerably in excess of that of any previous year. The directors, however, before recommending the payment of a dividend on the ordinary shares, have thought it wise to write off the whole of the special legal expenses (£205) incurred in former years. An important agreement has been entered into with the Società Negri for an all-day supply of electrical energy from their water-power station near San Remo, whereby possible competition has been avoided, and the profit-earning prospects of the company greatly improved. The balance standing to the credit of revenue account, including the sum brought forward from last year, is £959. The preference shares receive 5½ per cent. for the year, and £204 is carried forward.

## Prospectus.

The list was to close yesterday in an issue of 42,500 £1 shares in the Electrical Bleaching Co. (1904), Ltd. There are to be issued, in payment of purchase money, £17,500 fully-paid shares, and 15,000 shares are held in reserve, the total nominal capital being £75,000. The company is to acquire certain patents (known as the Vogelsang electrical system) for improvements in the electrical bleaching of cotton cloth and yarn. The process is said to be in successful working operation in Nottingham on a commercial basis, but an exclusive licence is already held by another company for a radius of 25 miles from Nottingham for bleaching lace and lace curtains. There are also stated to be some 40 works in Germany and Austria employing the system. The company will take over from the Electrical Bleaching Co., Ltd., of Nottingham, its assets, and from Mr. C. E. W. Gaddum, the promoter, an estate at Edenfield, near Bury, whereon are situated works well adapted for bleaching and finishing, and £7,500 is to be expended upon additional bleaching and finishing plant. The lasting power of the electrolyser in the Vogelsang system is claimed to be a highly important element of the process. The list of directors includes two electrical engineers, Mr. G. St. John Day, Mumps Electrical Works, of Oldham, and Mr. E. L. Thorpe, of Nottingham.

## Direct United States Cable Co.

Mr. E. M. Underdown, K.C., presided at the meeting held on Tuesday at Winchester House. In moving the adoption of the report (see Electrical Review, July 22nd), he went briefly over the figures, and said that the directors would have been glad to have laid before them a larger figure for receipts, but they were not able to do so, purely because of the falling off in the business of the world, of which the company represented the pulse to a certain extent. The working expenses and the general expenses at stations were practically the same as last year. The reserve fund had been credited with the interest on the investments and the £6,000 which had been transferred from the revenue. It had been debited with the cost of cable repairs, and the balance stood at £463,953 at cost. The cable interruptions had been dealt with expeditiously and successfully. They had had the advantage of securing the assistance of a ship on the other side of the Atlantic upon economical terms, and the result was that, notwithstanding

that they had some very serious repairs, the reserve was not affected to a greater extent than about £10,000. The cables were now in perfectly good condition. The directors had not lost sight of the question of a pension fund for the company's employés. Such a system had been adopted by nearly all the cable companies, and the directors of this company had studied it; there were circumstances with regard to this company which placed it in a somewhat different position from that of the other companies, but they would continue to study the question, and when any plan was resolved upon they would place it before the shareholders for approval.

Sir J. Fender seconded the motion, which was adopted.

The retiring directors and auditor's were re-elected.

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**St. James's and Pall Mall Electric Light Co.**—The amount of electricity sold for the quarter ended midsummer, 1904, is returned at 1,431,553 units, estimated to produce £22,964, as against 1,460,572 units, which produced £23,612 for the corresponding period of last year.

**Blackheath and Greenwich District Electric Light Co.**—Letters of allotment for a further £30,000 4½ per cent. first mortgage debenture stock and a further 30,000 7 per cent. cumulative preference shares of the company were posted early in the week. Both issues were over-subscribed by the company's shareholders and debenture stockholders.

**County of London Electric Supply Co.**—For the half-year to June 30th an interim dividend is declared on the ordinary shares at the rate of 4 per cent. per annum, less income-tax, payable on August 22nd. The amount of electricity sold in the company's London districts during the half-year ended June 30th is estimated to realise £59,338, which compares with £49,854 for the corresponding period last year.

**Metropolitan Electric Supply Co.**—An interim dividend of 9s. per share is declared on the ordinary shares, being at the rate of 9 per cent. per annum, and payable on August 9th.

**Metropolitan Railway Co.**—The report for the half-year ended June 30th, 1904, says:—"The works required for the electrification of the line have proceeded rapidly during the past six months, and in the course of a short time the testing of the machinery and plant under normal conditions of working will take place. Thirteen trains of new corridor cars have already been constructed, and are being electrically equipped at Neasden. The rest of the rolling stock necessary for the new system of working is in course of construction at Manchester and Birmingham. The board have elected the deputy chairman, Sir Charles McLaren, Bart., M.P., to the position of chairman, and Sir William Birt to the deputy chairmanship. The number of passengers carried during the half-year was 47,572,443, and the gross receipts from passengers, goods, minerals and tolls, £417,590."

**Newcastle and District Electric Lighting Co.**—The directors have declared an interim dividend of 7 per cent. per annum for the half-year ending June 30th. This is the same rate as has been paid for the last six years as an interim dividend.

**Liverpool Overhead Railway Co.**—The accounts for the past half-year show an available balance of £10,370 18s. 6d., and the directors have resolved to recommend payment of a dividend at the rate of 5 per cent. per annum on the preference shares, and 1½ per cent. per annum on the ordinary shares, against 1¼ per cent. per annum on the ordinary shares for the corresponding period last year. Balance carried forward £4,052 against £3,747.

**Great Northern, Piccadilly and Brompton Railway Co.**—The report for the half-year ended June 30th last states that the capital expenditure during the half-year amounted to £717,190. The estimate for the current half-year is £900,000. From the engineers' reports, it appears that the progress of the works during the past half-year has been most satisfactory. With one exception, all of the station sites are in the possession of the contractors. The rent due from the Underground Electric Railways Co. of London, Ltd., under the terms of the agreement for lease, dated January 13th, 1903, up to June 30th, 1904, permits of a dividend at the rate of 4 per cent. per annum.

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## STOCKS AND SHARES.

Wednesday Evening.

Bank-holiday prospects affect the steam railway companies more than those of any other class in the Stock Exchange lists, and they exert little influence over electrical railway prices. These last are accordingly swayed more by such forces as the Money Market and absence of business than by anything else at the moment, and the same observation practically covers the other sections with which we have to deal. Supply shares are inert, and the Telegraph market has few outstanding features. The widest movement in shares that we have to notice this week does not exceed 10s., and, with regard to stocks, the greatest change is a fluctuation of 1 per cent.

Central London issues have diminished a trifle, the prices being narrowed at the expense of the higher quotations. The dividend, which we reported last week, came up to the general anticipation, while the reduced carry-forward is supposed to forecast a lower dividend on the Deferred stock at the end of the year. City and South London stock keeps at 48, Waterloo & City at 90½ on the eve of the announcement, while Districts are duller at 36, although the company fulfils anticipation by paying at the rate of 2 per cent. per annum on its guaranteed stock. Metropolitan Consolidated also gave way to 94½ upon the general dulness in the market, due to political fears. Great Northern and City Preferred "A" shares are 4¼. Great Northern, Piccadilly and Brompton Ordinary are 9½, and the expenditure for the last half-year is announced at £717,190. The Baker Street and Waterloo Railway, in reporting a capital expenditure of £140,384 for the past half-year, draws attention to the steady way in which work is progressing along its system. It would seem probable that something like £260,000 will have to be raised during the current six months to meet the necessary payments. More capital, too, will shortly be required by the City and South London, and probably the knowledge of this has something to do with the low price of the Ordinary stock.

One of the 10s. changes already referred to is an advance of that amount in Metropolitan Electric Ordinary. By the time this copy of the paper is issued, the shares will be quoted *ex* the return of £6 capital to the shareholders, and an impression gained ground that the price would be tempting at anything like 15 or 16, in view of the proposed re-arrangement of the shares. City of London second Debenture at 103½, and St. James's 3½ per cent. Debenture at 98½, have risen a point each, notwithstanding the threatening foreign outlook and the harder tone of the Money Market that are so largely responsible for the dulness in Consols and high-class securities of all descriptions. Calcutta Electric Supply are ¼ up and 7¼. Except for this quartette of alterations, the Electricity Supply section is unchanged.

Nor are Miscellaneous varieties much livelier. Callender's Preference at 5¼ have receded 5s., and a fall of like amount has left Crompton shares at 1⅞. What connection, if any, there may be between this movement and a recent issue, we can only guess. British Westinghouse Debenture was done at 86½ on Tuesday, and the Preference remain about 3½. Babcock & Wilcox Ordinary on the same day were sold at 2⅞. Willans & Robinson are 2½ and 3½ for Ordinary and Preference respectively.

Much is being said about the proposed new system for conveying parcels by pneumatic tube—a revival of a much-discussed idea, but the financial aspects do not seem to appeal as weightily as they should to the supporters of the scheme. An immense outlay would be necessary in the first place, and we have before us a preliminary prospectus for putting the scheme upon its earliest financial footing. Cruelly enough, we are forbidden to set out the essential details at the moment, and can add no more than that the sum said to be required for the proper exploitation of the idea would take away the breath of certain South American Republics which might be named.

Cuba Telegraph shares have risen 10s. to 7½ upon the more hopeful prospects now ahead of the modern "distressful isle," and Eastern Telegraph Ordinary hardened 1 by reason of the chairman's speech at the recent meeting. Sir J. Wolfe Barry showed that the Eastern Co. is fully alive to the necessity for keeping abreast of wireless developments, and long ago, in discussing the situation at the time of the first Marconi scare, we suggested that the cable companies were quite able to look after their own interests by the adoption of wireless methods. Marconi shares are now 1¼ to 1⅜. Western Telegraph Ordinary have lost ¼ at 12½. National Telephone stocks keep steady, but the Deferred has shed a point at 89½, the meeting providing no great reason for optimism with regard to the Post Office negotiations yet awhile.

Business in Traction varieties is fairly active. Buenos Ayres and Belgrano Ordinary are being freely dealt in at about 3, and the "A" Preferred shares are 5½, which is ¼ higher than the price of the "B." British Electric Traction Preference at 11 have risen ¼, and Metropolitan Electric Tramway Deferred came into notice at 5s. 3d. upon the opening of the first part of the electrified lines. The Metropolitan Electric Tramways is, of course, one of the British Electric Traction side-shows. Cape Electrics are steady at 1⅞. Anglo-Argentine Preference have hardened ¼ to 5¼, and City of Buenos Ayres have slightly receded to a fraction under 10. Calcutta Trams at 7½ show no change.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1901. | 1902. | 1903. | Closing Quotations July 20th. | Closing Quotations July 27th. | Business done week ended July 27th, 1904. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 67,100 | African Direct Telegraph, 4 % Debs. | 100 | .. | .. | .. | 97 —101 | 97 —101 | .. | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | .. | .. | .. | 2⅛ — 8½ | 2⅛ — 8½ | .. | .. |
| 119,700£ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | .. | .. | .. | 70 — 80 | .. — .. | .. | .. |
| 788,840 | Anglo-American Telegraph | Stock | 61s. | 60/6 | 61s. | 46 — 49 | 46 — 49 | 46 | .. |
| 3,105,580 | Do. do. do. 6 % Pref. | Stock | 6 % | 6 % | 6 % | 91 — 93 | 91 — 93 | 92⅝ | 91½ |
| 3,105,580 | Do. do. do. Deferred | Stock | 2s. | 1/- | 2s. | 6⅛ — 7 | 6⅛ — 7 | .. | .. |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 5 % | 6 % | 7 % | 5 — 5½ | 5 — 5½ | .. | .. |
| 18,333,300$ | Commercial Cable | $100 | 8 % | 8 % | .. | 170 —190 | 170 —190 | .. | .. |
| 1,841,209 | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | .. | .. | .. | 93 — 95 | 93 — 95 | 94⅛ | 93½ |
| 16,000 | Cuba Telegraph | 10 | 4 % | 6½% | 5 % | 6⅛ — 7⅛ | 7 — 8 | 7⅝ | .. |
| 6,000 | Do. 10 % Pref. | 10 | .. | .. | .. | 15 — 16 | 15 — 16 | .. | .. |
| 12,981 | Direct Spanish Telegraph | .. | .. | .. | .. | .. — .. | .. — .. | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | .. | .. | .. | 7 — 8 | 7 — 8 | .. | .. |
| 80,000 | Do. do. 4½ % Debs. | 50 | .. | .. | .. | 98 —101⅝ | 98 —101 ⅝ | .. | .. |
| 60,710 | Direct United States Cable | 20 | 3½% | 3½% | 3 % | 10 — 10½ | 10 — 10½ | .. | .. |
| 81,800 | Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 99 —101 | 99 —101 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 7 % | 7 % | 7 % | 126 —131 | 127 —132 | 131½ | 129⅝ |
| 1,955,555 | Do. 3½ % Pref. Stock | 100 | .. | .. | .. | 86 — 89 | 87 — 90 | 88½ | 87½ |
| 1,584,645 | Do. 4 % Mort. Deb. Stock Red. | Stock | .. | .. | .. | 105 —108 | 105 —108 | 106⅝ | 105⅝ |
| 800,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | 7 % | 11⅞ — 12¼ xd | 11⅞ — 12¼ | 12¼ | 12 |
| 320,000£ | Do. 4 % Deb. Stock | Stock | .. | .. | .. | 105 —108 | 105 —108 | .. | .. |
| 800,000 | Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 200,000£ | Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 180,297 | Globe Telegraph and Trust | 10 | 5½% | £3 16 7* | 5½% | 8⅞ — 9⅛ | 8⅞ — 9⅛ | 9⅛ | 8⅞ |
| 180,042 | Do. do. 6 % Pref. | 10 | .. | .. | .. | 13⅛ — 13⅝ | 13⅛ — 13⅝ | 13⅝ | 13⅛ |
| 160,000 | Great Northern Telegraph, of Copenhagen | 10 | 15 % | 12½% | 15 % | 25½ — 26½ | 25½ — 26½ | 25½ | .. |
| 54,700 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 99 —101 | 99 —101 | .. | .. |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10% | 10 % | 42 — 45 | 42 — 45 | .. | .. |
| 1,968,333 | National Telephone, Pref. Stock | 100 | 5 % | 6 % | 6 % | 106 —108 | 106 —108 | 107½ | 106½ |
| 1,966,667 | Do. do. Def. Stock | 100 | .. | 4½% | 5 % | 89 — 92 | 88 — 91 | 90 | 88 |
| 15,000 | Do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 12 — 14 | 12 — 14 | .. | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 11 — 13 | 11 — 13 | .. | .. |
| 2,250,000 | Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5⅛ — 5⅜ | 5⅛ — 5⅜ | 5⅛ | 5⅛ |
| 000,000£ | Do. do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 3½% | 97 — 99 | 97 — 99 | 98½ | .. |
| 689,593 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 103 —105 | 103 —105 | .. | .. |
| 1,000,000 | Do. do. Prov. Certs., 85 % to be paid | .. | .. | .. | .. | 29 — 31 | 64 — 66 | 65 | .. |
| 179,313 | Oriental Telephone and Elec. Nos. 1 to 171,594, fully paid | 1 | 6 % | 6 % | 6½% | ⅛ — 1⅛ | ⅛ — 1⅛ | .. | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. | 1 | .. | .. | .. | 1 — 1⅛ | 1 — 1⅛ | .. | .. |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 11,889 | Reuter's | 8 | 5 % | 5 % | .. | 6½ — 7½ | 6½ — 7½ | 6½ | .. |
| 3,308 | Submarine Cables Trust | Certs. | .. | .. | .. | 118 —123 | 118 —123 | .. | .. |
| 58,000 | United River Plate Telephone | 5 | 7 % | 7 % | .. | 6 — 6½ | 6 — 6½ | 6⅛ | .. |
| 40,000 | Do. do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | .. | .. | .. | 4⅞ — 5⅛ | 4⅞ — 5⅛ | 5⅛ | 5 |
| 179,947£ | Do. do. 5 % Debs. | Stock | .. | .. | .. | 103 —106 | 103 —106 | .. | .. |
| 15,609 | West African Telegraph, Shares | 10 | .. | 2 % | 4 % | 6 — 7 | 6 — 7 | .. | .. |
| 150,000£ | West Coast of America, 4% Debs., 1 to 1,500 guar. by Brax. Sub. Tel. | 100 | .. | .. | .. | 95 — 98 | 97 —100 | .. | .. |
| 207,980 | Western Telegraph, Ltd., Nos. 1 to 207,980 | 10 | 7½% | 7 % | 7 % | 12½ — 13 | 12½ — 12⅝ | 12⅝ | 12½ |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 | 100 | .. | .. | .. | 101 —104 | 101 —104 | 10½ | .. |
| 400,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 99 —102 | 99 —102 | 99½ | .. |
| 88,891 | West India and Panama Telegraph | 10 | .. | .. | .. | ⅜ — ½ | ⅜ — ½ | .. | .. |
| 84,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | .. | .. | .. | 6½ — 6⅝ | 6½ — 6⅝ | .. | .. |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | .. | .. | .. | 5 — 6 | 5 — 6 | .. | .. |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,600 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 90,000 | British Aluminium 7 % Cum. Pref. | 10 | .. | .. | .. | 5 — 6 | 5 — 6 | .. | .. |
| 800,000£ | Do. do. 5 % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 92 — 97 | 92 — 97 | .. | .. |
| 100,000 | British Electric Traction | 10 | 9 % | 8 % | .. | 8½ — 9 xd | 8½ — 9 | 8⅝ | 8⅜ |
| 100,000 | Do. do. 6 % Cum. Pref. | 10 | .. | .. | .. | 10⅜ — 11 | 10⅞ — 11⅛ | 10⅞ | 10⅞ |
| 600,000£ | Do. do. 5 % Perpetual Debenture Stock | Stock | .. | .. | .. | 116 —119 | 116 —119 | 118½ | 118½ |
| 100,000 | British Insulated and Helsby Cables | 5 | 10 % | 10 % | 8 % | 5⅞ — 6⅛ | 5⅞ — 6⅛ | .. | .. |
| 100,000 | Do. do. 6 % Cum. Pref. | 5 | .. | .. | .. | 6¼ — 6½ | 6⅛ — 6¼ | .. | .. |
| 50,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 50,000 | ¶Browett, Lindley & Co., Ord. | £1 | Nil | .. | .. | ⅞ — 1⅛ | ⅞ — 1⅛ | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. | £1 | 6 % | .. | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. |
| 105,731 | Brush Electrical Engineering, Ord., 1 to 105,731 | 2 | Nil | Nil | Nil | ¾ — 1 | ¾ — 1 | .. | .. |
| 150,000 | Do. do. Non-cum. 6 % Pref. | 2 | 3 % | 6 % | 6 % | 1¼ — 1½ | 1¼ — 1½ | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. 2nd Deb. Stock | Stock | .. | .. | .. | 71 — 76 | 71 — 76 | .. | .. |
| 85,000 | Callender's Cable Construction shares | 5 | 20 % | 15 % | 12½% | 9⅜ — 10⅛ | 9⅜ — 10⅛ | 10⅛ | .. |
| 40,000 | Do. do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 6½ — 6⅝ | 6 — 6⅛ | 6⅛ | .. |
| 90,000£ | Do. do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 101 —105 | 101 —105 | 102½ | 101¾ |
| 1,860,014 | Central London Railway, Ord. Stock | Stock | 4 % | 4 % | 4 % | 89 — 92 | 89 — 91 | 90⅜ | 89 |
| 494,098 | Do. do. 4 % Pref. Stock | Stock | 4 % | 4 % | 4 % | 102 —105 | 103 —104 | 103⅛ | .. |
| 494,998 | Do. do. Def. do. | Stock | 4 % | 4 % | 4 % | 79 — 82 | 79 — 81 | .. | .. |
| 1,330,000 | City and South London Railway | Stock | 2 % | 3½% | 2¾% | 47 — 49 | 47 — 49 | 48⅛ | 47½ |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 5 | 7½% | 5 % | .. | 1⅞ — 2⅛ | 1⅞ — 2 | 1⅞ | .. |
| 100,000£ | Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red. | .. | .. | .. | .. | 94 — 97 | 94 — 97 | 94 | .. |
| 99,261 | Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261 | 1 5 | Nil | Nil | .. | ¼ — ¾ | ¼ — ¾ | .. | .. |
| 17,189 | Do. do. "A" shares, 01—017,189 | 1 5 | Nil | Nil | .. | 1 — 2 | 1 — 2 | .. | .. |
| 44,023£ | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 77 — 82 | 77 — 82 | .. | .. |
| 100,000£ | Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd. | 100 | .. | .. | .. | 78 — 82 | 78 — 82 | .. | .. |
| 12,100 | Electric Construction, 1 to 112,100 | 2 | 6 % | 6 % | 4½% | 1½ — 1⅝ | 1 — 1½ | 1⅛ | 1⅜ |
| 81,890 | Do. do. 7 % Cum. Pref., 1 to 81,890 | 2 | .. | .. | .. | 2⅛ — 2⅜ | 2⅛ — 2⅛ | .. | .. |
| 82,500£ | Do. do. 4 % Perp. 1st Mort. Deb. Stock | Stock | .. | .. | .. | 96 — 99 xd | 96 — 99 | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 5 % | 5 % | .. | 9 — 9⅛ | 9 — 9⅛ | 9⅛ | .. |
| 200,000 | Do. do. 4 % Mort. Deb. | Stock | .. | .. | .. | 93 — 98 | 93 — 98 | .. | .. |
| 200,000 | Henley's (W. T.) Telegraph Works, Ord. | 5 | 20 % | 20 % | 15 % | 11 — 12 | 11 — 12 | 11⅛ | 11 |
| 200,000 | Do. do. 4½ % Pref. | 5 | .. | .. | .. | 5 — 5⅛ | 5 — 5⅛ | .. | .. |
| 45,900 | Do. do. 4½ Mort. Deb. Stock | Stock | .. | .. | .. | 107 —111 | 107 —111 | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works | 10 | 10 % | 10 % | .. | 18⅛ — 19½ | 18⅛ — 19½ | .. | .. |
| 800,000£ | Do. do. do. 4 % 1st Mort. Deb. | 100 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 87,500 | †Liverpool Overhead Railway, Ord. | 10 | 1½% | 1½% | .. | 3⅞ — 4 | 3⅞ — 4 | .. | .. |
| 10,000 | † Do. do. Pref. £10 paid | 10 | .. | .. | .. | 10 — 10½ | 10 — 10½ | .. | .. |
| 87,880 | Telegraph Construction and Maintenance | 12 | 20 % | 20 % | 20 % | 36 — 39 | 36 — 39 | 36½ | .. |
| 150,000£ | Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 540,000£ | Waterloo & City Railway, Ord. Stock | 100 | 3 % | 3⅛% | 3⅛% | 89 — 92 | 89 — 92 | .. | .. |

* period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904

## SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

| Present issue. | NAME. | Stock or Share. | Dividends for the last three years 1901. | 1902. | 1903. | Closing Quotations July 20th. | Closing Quotations July 27th. | Business done week ended July 27th, 1904. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 100,000 | Blackheath and Greenwich Dist. Electric Light, Ord... | £1 | .. | .. | .. | ⅜— ⅞ | ⅜— ⅞ | .. | .. |
| 50,000 | Do. 7 % Pref. | £1 | .. | .. | .. | 1⅜— 1⅝ | 1⅜— 1⅝ | 1⅜ | .. |
| 100,000 | Do. 4½% 1st Deb. Stock | £100 | .. | .. | .. | 100 —105 | 100 —105 | 102½ | .. |
| 20,000 | Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 | £5 | 8 % | 8 % | 10 % | 10⅝— 11½ | 10⅝— 11½ | 11⅛ | .. |
| 20,000 | Do. do. 7 % Cum. Pref. | £5 | .. | .. | .. | 10½— 10¾ | 10½— 10¾ | .. | .. |
| 250,000 | Central Electric Supply 4 % Guar. Deb. Stock .. .. .. | £100 | .. | .. | .. | 105 —108 | 105 —108 | .. | .. |
| 50,000 | Charing Cross and Strand Electricity Supply .. .. .. | £5 | 10 % | 10 % | 8 % | 7½— 8 | 7½— 8 | 7⅞ | .. |
| 70,000 | Do. do. do. 4½% Cum. Pref. | £5 | .. | .. | .. | 5⅛— 5½ | 5⅛— 5½ | 5½ | 5⅜ |
| 40,000 | Do. do. "City Undertaking" 4½% Cum. Pref. | £5 | .. | .. | .. | 4½— 5 | 4½— 5 | .. | .. |
| 40,000 | Do. do. 1903 .. .. .. .. | £5 | .. | .. | .. | 4½— 5 | 4½— 5 | 4⅛ | 4⅛ |
| 250,000 | Do. do. 4 % Deb. Stock Red. .. .. .. | £100 | .. | .. | .. | 102 —104 | 102 —104 | 103½ | .. |
| 44,436 | *Chelsea Electricity Supply, Ord. .. .. .. .. | £5 | 4 % | 4½% | 5⅓% | 6½— 6¾ | 6½— 6¾ | .. | .. |
| 150,000‡ | Do. do. % Deb. Stock Red. .. .. .. | Stock | .. | .. | .. | 106 —109 | 106 —109 | .. | .. |
| 70,595 | City of London Electric Lighting, Ord. 40,001—110,595 | £10 | 5 % | 5 % | 5 % | 10⅜— 11¼ xd | 10⅜— 11¼ | 10⅜ | 10⅛ |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 .. .. .. | £10 | .. | .. | .. | 13 — 14 | 13 — 14 | .. | .. |
| 400,000‡ | Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid .. | .. | .. | .. | .. | 120 —125 | 120 —125 | .. | .. |
| 800,000 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid .. | £100 | .. | .. | .. | 101 —104 | 102 —105 | 104 | 103½ |
| 40,000 | County of London Electric Lighting, Ord. 1—40,000 | £10 | 4 % | 4 % | 4 % | 7⅞— 8¼ | 7⅞— 8¼ | 8 | .. |
| 20,000 | Do. do. do. 6 % Pres. 40,001—60,000.. | £10 | .. | .. | .. | 11 — 12 | 11 — 12 | 11⅞ | 11 |
| 400,000‡ | Do. do. 4½% Deb. Stock .. .. .. | .. | .. | .. | .. | 105 —108 | 105 —108 | .. | .. |
| 250,000 | Do. do. 4½% 2nd Deb. Stock .. .. .. | Stock | .. | .. | .. | 100 —103 | 100 —103 | 101 | .. |
| 50,000 | Edmundson's Electric Corporation, Ord. Shares .. .. | £5 | 7 % | 7 % | 7 % | 6 — 6¼ | 6 — 6¼ | 6⅛ | .. |
| 80,000 | Do. do. 6 % Cum. Pref. .. .. .. | £5 | .. | .. | .. | 5⅞— 6 | 5⅞— 6 | 5⅞ | 5⅞ |
| 140,000 | Do. do. 4½% 1st Mort. Deb. Stock .. | £100 | .. | .. | .. | 104 —107 xd | 104 —107 | .. | .. |
| 21,000 | Kensington and Knightsbridge Electric Ord. .. .. .. | £5 | 10 % | 10 % | 12½ | 12 — 13 | 12 — 13 | .. | .. |
| 90,000 | Do. do. do. 4 % Debenture Stock .. | Stock | .. | .. | .. | 102 —105 | 102 —105 | .. | .. |
| 110,000 | London Electric Supply Corporation, Limited, Ord. .. .. | £1 | .. | .. | .. | 1⅛— 1⅜ | 1⅛— 1⅜ | 1⅜ | .. |
| 49,840 | Do. do. do. 6 % Pref. .. .. .. | £5 | .. | .. | .. | 4¾— 5⅛ | 4¾— 5⅛ | .. | .. |
| 250,000‡ | Do. do. do. 4 % 1st Mort. Deb. Stock Red | Stock | .. | .. | .. | 94 — 95 | 94 — 97 | 96 | 94½ |
| 100,000 | Metropolitan Electric Supply, 1 to 100,000 .. .. .. .. | £10 | 6¼% | 7½% | 8⅓% | 21 — 22 | 21½— 22½ | 22⅜ | 21⅝ |
| 71,106 | Do. do. 4½% Cum. Pref. 1—71,106, £3 paid .. | £5 | .. | .. | .. | 5¼— 5⅜ | 5⅛— 5⅜ | 5 5/32 | 5 9/32 |
| 230,000‡ | Do. do. 4½% 1st Mort. Deb. Stock .. .. | .. | .. | .. | .. | 108 —112 | 108 —112 | .. | .. |
| 250,000‡ | Do. do. 3¾% Mort. Deb. Stock Red .. .. | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 10,859 | Notting Hill Electric Lighting .. .. .. .. .. | £10 | 6 % | 6 % | 6 % | 12½— 14½ | 13½— 14½ | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. .. .. .. | £5 | 14½% | 14½% | 14½% | 14½— 15½ | 14½— 15½ | 14⅝ | .. |
| 20,000 | Do. do. do. 7 % Pref. 20,001 to 40,000 | £5 | .. | .. | .. | 8 — 9 | 8 — 9 | 8¼ | .. |
| 150,000‡ | Do. do. do. 3¾% Deb. Stock Red .. | £100 | .. | .. | .. | 96 — 99 | 97 —100 | 98¾ | 97⅛ |
| 12,000 | Smithfield Markets Electric Supply, Ord. .. .. .. | £5 | .. | 2½% | 4 % | 2⅜— 3½ | 2⅜— 3½ | .. | .. |
| 50,000 | Do. do. do. 4 % Deb. Stock .. .. | Stock | .. | .. | .. | 85 — 90 | 85 — 90 | .. | .. |
| 65,000 | South London Electricity Supply, Ord. .. .. .. .. | £5 | .. | 1½% | 3 % | 3½— 4¼ | 3⅝— 4¼ | 4⅜ | 4¼ |
| 80,000 | Urban Electric Supply, Ord. .. .. .. .. .. | £5 | .. | .. | .. | 4½— 5 | 4½— 5 | 4 31/32 | 4 13/16 |
| 80,000 | Do. do. 5 % Cum. Pref. .. .. .. .. | £5 | .. | .. | .. | 4½— 5 | 4½— 5 | .. | .. |
| 110,000 | Westminster Electric Supply, Ord. .. .. .. .. | £5 | 10½% | 12 % | 13⅓% | 12½— 13½ | 12¾— 13½ | 13 1/16 | 12⅝ |
| 28,141 | Do. do. 5 % Cum. Pref. .. .. .. .. | £5 | .. | .. | .. | 6 — 6¼ xd | 6 — 6¼ | .. | .. |

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

## MARKET QUOTATIONS, Wednesday, July 27th.

| | CHEMICALS, &c. | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|---|
| a | Acid, Hydrochloric .. .. .. | per cwt. | 5/- | .. |
| a | ,, Nitric .. .. .. .. | per cwt. | 22/- | .. |
| a | ,, Oxalic .. .. .. .. | per cwt. | 32/- | .. |
| a | ,, Sulphuric .. .. .. | per cwt. | 5/6 | .. |
| a | Ammoniac, Sal .. .. .. | per cwt. | 42/- | .. |
| a | Ammonia, Muriate (crystal) .. | per ton | £33 10 | .. |
| a | ,, ,, .. .. .. | per ton | £30 | .. |
| a | Bleaching powder .. .. .. | per ton | £4 10 | .. |
| a | Bisulphide of Carbon .. .. | per ton | £15 | .. |
| a | Borax .. .. .. .. .. | per ton | £18 | .. |
| a | Benzole (90 %) .. .. .. | per gal. | 7/- | .. |
| a | ,, (50/90 %) .. .. .. | per gal. | 5/6 | .. |
| a | Copper Sulphate .. .. .. | per ton | £21 10 | .. |
| a | Lead, Nitrate .. .. .. | per ton | £24 | .. |
| a | ,, White Sugar .. .. .. | per ton | £31 | .. |
| a | ,, Peroxide .. .. .. | per ton | £27 10 | .. |
| a | Methylated Spirit .. .. .. | per gal. | 2/6 | .. |
| a | Naphtha, Solvent (90% a 160° C). | per gal. | 5/6 | .. |
| a | Potash, Bichromate, in casks .. | per lb. | 8d. | .. |
| a | ,, Caustic (75/80%) .. .. | per ton | £24 | .. |
| a | ,, Bisulphate .. .. | per ton | £35 | .. |
| a | Shellac .. .. .. .. | per cwt. | 200/- | .. |
| a | Sulphate of Magnesia .. .. | per ton | £4 10 | .. |
| a | Sulphur, Sublimed Flowers .. | per ton | £6 10 | .. |
| a | ,, Recovered .. .. | per ton | £5 10 | .. |
| a | ,, Lump .. .. .. | per ton | £5 | .. |
| a | Soda, Caustic (white 70 %) .. | per ton | £10 15 | .. |
| a | ,, Crystals .. .. .. | per ton | £3 | .. |
| a | ,, Bichromate, casks .. .. | per lb. | 2½d. | .. |
| | **METALS, &c.** | | | |
| b | Aluminium Ingots, in ton lots .. | per ton | £130 | .. |
| b | ,, Wire, in ton lots .. | per ton | £168 | .. |
| b | ,, Sheet, in ton lots .. | per ton | £166 | .. |
| p | Babbitt's metal ingots .. .. | per ton | £43 to £130 | .. |
| c | Brass (rolled metal 2' to 12') basis | per lb. | 6¼d. | .. |
| c | ,, Tube (brazed) .. .. | per lb. | 8¼d. | .. |
| c | ,, ,, (solid drawn) .. .. | per lb. | 7¼d. | .. |
| c | ,, Wire, basis .. .. .. | per lb. | 6¾d. | .. |
| c | Copper Tubes (brazed) .. .. | per lb. | 9½d. | .. |
| c | ,, ,, (solid drawn) .. | per lb. | 9¼d. | .. |
| c | Copper Bars (best selected .. | per ton | £70 | .. |

| | METALS, &c. (continued). | | Latest Price. | Week's Dec. or Inc. |
|---|---|---|---|---|
| g | Copper Sheet .. .. .. | per ton | £70 | .. |
| g | ,, Rod .. .. .. .. | per ton | £70 | .. |
| e | ,, (Electrolytic) Bars .. | per ton | £63 | .. |
| e | ,, ,, Sheets .. | per ton | £78 | .. |
| e | ,, ,, Rod .. .. | per ton | £73 | .. |
| e | ,, ,, H.C. Wire | per lb. | 7¾d. | .. |
| f | Ebonite Rod .. .. .. | per lb. | 3/8 | .. |
| f | ,, Sheet .. .. .. | per lb. | 8/- | .. |
| n | German Silver Wire .. .. | per lb. | 1/6 | .. |
| h | Gutta-percha fine .. .. .. | per lb. | 8/- | .. |
| h | India-rubber, Para fine .. .. | per lb. | 4/9½ to 4/10½ | .. |
| i | Iron, Charcoal Sheets .. .. | per ton | £18 | .. |
| i | ,, Pig (Cleveland warrants) | per ton | 42/10½ | 4½d. inc. |
| i | ,, Forgings, according to size | per ton | From £11 | .. |
| i | ,, Scrap, heavy .. .. | per ton | 47/6 to 50/- | .. |
| i | ,, Wire, galvanised No. 8 .. | per ton | £9 15 | .. |
| g | Lead, English Ingot .. .. | per ton | £11 17 6 to £12 | inc. |
| g | ,, ,, Sheet .. .. | per ton | £11 17s. 6d. | .. |
| m | Manganin Wire No. 28 .. .. | per lb. | 8/- | .. |
| g | Mercury .. .. .. .. | per bot. | £7 17 6 | .. |
| d | Mica (in original cases) small .. | per lb. | 6d. to 1/ | .. |
| d | ,, ,, ,, medium | per lb. | 2/6 to 4/- | .. |
| d | ,, ,, ,, large .. | per lb. | 4/6 to 8/6 | .. |
| p | Phosphor Bronze, plain castings | per lb. | 1/- to 1/5½ | .. |
| p | ,, rolled bars & rods | per lb. | 1/- to 1/8 | .. |
| p | ,, ,, strip & sheet | per lb. | From 1/1 | .. |
| o | Platinum .. .. .. .. | per oz. | £4 | .. |
| e | Silicium Bronze Wire .. .. | per lb. | 9d. to 11d. | .. |
| i | Steel, Magnet, acc'd'g to desc'p'n | per ton | £58 | .. |
| i | ,, ,, in bars .. .. | | £15 to £40 | .. |
| g | Tin, Block .. .. .. .. | per ton | £124 to £125 | £2 10 inc. |
| g | ,, Foil .. .. .. .. | per lb. | 1/6 | .. |
| n | ,, Wire, Nos. 1 to 16 .. .. | per lb. | 1/6½ | .. |
| p | White Anti-friction Metals— "White Ant" brand .. | per ton | £42 to £62 | .. |
| j | Yarns, 2/10s Grey Cotton, on sp'ls | per lb. | 8d. | .. |
| j | ,, 6 lea. Flax .. .. .. | per lb. | 5⅝d. | .. |
| j | ,, 3 ply 10 lbs. Russian .. | per lb. | 4⅛d. | .. |
| j | ,, 10 lbs. Russian, single .. | per lb. | 4½d. | .. |
| j | ,, 180 lbs. Jute rove .. | per ton | £11 | .. |
| k | Zinc, Sh't (Vieille Montagne brd.) | per ton | £25 5 | .. |

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co., f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Till & Co.; i Bolling & Lowe; j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| Locality. | Week ending | Receipts for the week. £ | £* | No. wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|
| Aberdeen .. .. | July 23 | 1,877 | +279 | 8 | 12,705 | + 2,292 | 10 | — |
| Bath .. .. .. | ,, 20 | 742 | — | 30 | 17,229 | — | 12½ | — |
| Birmingham .. .. | ,, 23 | 5,494 | +253 | 30 | 161,289 | +10,590 | 3½ | — |
| Blackburn .. .. | ,, 15 | 1,087 | +216 | 16 | 15,450 | + 1,310 | 13½ | — |
| Blackpool .. .. | ,, 21 | 1,950 | +137 | 16 | 15,920 | + 1,070 | 8½ | — |
| ,, —Fleetw'd | ,, 23 | 1,470 | + 79 | 4 | 3,571 | — 265 | 7½ | — |
| ,, —Lytham | ,, 21 | 795 | + 4 | 38 | 10,749 | + 5,877 | 7½ | — |
| Bolton .. .. | ,, 24 | 2,014 | — 34 | 17 | 31,922 | + 21 | 25 | — |
| Bournemouth .. | ,, 20 | 1,166 | +144 | 16 | 17,694 | — | 10½ | — |
| Bradford .. .. | ,, 16 | 5,211 | +1133 | 15 | 71,186 | +12,449 | 50 | — |
| Brighton .. .. | ,, 24 | 1,168 | +208 | — | 16,237 | — | 8 | — |
| Bristol .. .. | ,, 22 | 5,430 | —151 | — | — | — | 28 | — |
| Devonport .. | ,, 15 | 655 | +140 | 28 | 14,510 | + 2,402 | 5 | — |
| Dudley—Sto'rb'ge | ,, 15 | 1,005 | + 80 | 28 | 28,305 | + 807 | 18½ | — |
| Gateshead .. | ,, 15 | 1,008 | +117 | 28 | 25,054 | + 1,211 | 10½ | + ½ |
| Gr'n'k—Pt. Glsgw | ,, 15 | 700 | +115 | 28 | 15,249 | + 796 | 7½ | — |
| Oldham—Ashton | ,, 15 | 788 | + 35 | 28 | 15,113 | — 790 | 8 | — |
| Potteries .. .. | ,, 15 | 1,709 | +244 | 28 | 47,417 | + 3,990 | 28½ | — |
| South Staffs. .. | ,, 15 | 748 | —259 | 28 | 21,605 | — 2,007 | 21½ | — |
| Swansea .. .. | ,, 15 | 622 | —207 | 28 | 14,470 | + 589 | 5½ | — |
| Wolverhampton .. | ,, 15 | 464 | + 44 | 28 | 10,645 | — 196 | 10 | +8 |
| Yorks. Wool Dist. | ,, 15 | 717 | +340 | 28 | 16,832 | + 7,039 | 6 | — |
| Miscellaneous .. | ,, 15 | 4,561 | — | 28 | 82,760 | — | — | — |
| Burnley .. .. | ,, 23 | 1,103 | +214 | — | — | — | 10½ | +3½ |
| Burton-on-Trent .. | ,, 24 | 393 | — | 16½ | 6,818 | — | 8½ | — |
| Cardiff .. .. | ,, 23 | 2,162 | + 26 | 16 | 34,006 | + 813 | 14 | — |
| Chatham & District | ,, 21 | 722 | + 69 | 29 | 16,676 | + 2,152 | 9·53 | — |
| Cork .. .. .. | ,, 21 | 556 | — 89 | 29 | 13,161 | — 1,144 | 9 | — |
| Dover .. .. .. | ,, 23 | 975 | + 3 | 29 | 5,964 | — 310 | 8½ | — |

| Locality. | Week ending | Receipts for the week. £ | £* | No. wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|
| Dublin .. .. | July 22 | 5,752 | —4268 | — | 17,337 | — 2,959 | 47 | + ½ |
| East Ham .. .. | ,, 23 | 811 | +111 | 16 | 12,648 | + 199 | 5 | + ¼ |
| Glasgow .. .. | ,, 23 | 11,993 | +532 | 8 | 110,555 | + 2,555 | 71½ | +6½ |
| Halifax (2 weeks) .. | ,, 13 | 3,495 | +447 | 15 | 23,006 | + 1,594 | 33 | +1½ |
| Huddersfield .. | ,, 23 | 1,878 | + 90 | 16 | — | — | 28 | — |
| Hull .. .. .. | ,, 23 | 2,170 | +259 | 16 | 35,038 | + 4,229 | 13 | +2½ |
| Ilkeston .. .. | ,, 20 | 154 | — 37 | 16 | 2,375 | — | 3·5 | — |
| Ipswich .. .. | ,, 23 | 580 | — | 16 | 8,263 | — | 10½ | — |
| Isle of Thanet .. | ,, 23 | 1,440 | +112 | 29 | 15,074 | — 216 | 10½ | — |
| Leeds .. .. .. | ,, 23 | 5,971 | + 13 | — | 100,140 | + 5,908 | 81½ | +2 |
| Liverpool .. .. | ,, 16 | 11,795 | +1095 | 29 | 293,249 | + 7,499 | 108 | — |
| London C. C. .. | ,, 16 | 14,710 | +4035 | 15 | 185,758 | +33,115 | 39⅞ | — |
| Manchester .. .. | ,, 23 | 18,152 | +735 | 16 | 199,678 | + 6,861 | 131½ | — |
| Newcastle .. .. | ,, 23 | 3,660 | +145 | — | — | — | 17 | — |
| Portsmouth .. .. | ,, 28 | 2,492 | +466 | — | 33,629 | + 3,052 | 14½ | — |
| Salford .. .. | ,, 18 | 4,402 | +263 | — | 64,676 | + 5,259 | 30 | — |
| Sheffield .. .. | ,, 24 | 4,861 | + 98 | 17 | 81,247 | + 2,104 | 33 | +5½ |
| Southampton .. | ,, 21 | 1,068 | — 46 | — | — | — | 9 | — |
| Southend-on-Sea .. | ,, 20 | 512 | + 91 | 16 | 5,666 | + 534 | 6½ | — |
| Sunderland .. .. | ,, 24 | 1,564 | +138 | 16 | 21,521 | + 890 | 20 | +1 |
| Tyneside .. .. | ,, 20 | 479 | +132 | 29 | 10,841 | + 1,991 | 8·9 | +·4 |
| West Ham .. .. | ,, 21 | 1,127 | — | 21 | 16,606 | — | 8 | — |
| Wolverhampton .. | ,, 20 | 806 | +344 | — | — | — | 9·5 | — |
| Cen. London Rly. .. | ,, 23 | 6,057 | —315 | 3 | 18,733 | — 1,141 | 6 | — |
| City & S. Lon. Rly. .. | ,, 24 | 2,316 | —229 | 4 | 9,435 | — 528 | 6½ | — |
| Dublin—Lucan Rly. | ,, 22 | 153 | + 28 | 3 | 458 | + 118 | 7 | — |
| G. N. and City Ry. | ,, 23 | 965 | + 6 | 28 | 21,353 | — | 3½ | — |
| L'pool Overh'd Rly. | ,, 24 | 1,894 | +184 | 4 | 6,977 | + 135 | 6½ | +4½ |
| Mersey Railway .. | ,, 23 | 1,594 | +280 | 3 | 4,407 | + 341 | 4½ | — |

* Compared with the corresponding period of 1903.

# THE MUNICIPAL ELECTRICAL CONVENTION.

## THE ORGANISATION AND MANAGEMENT OF A CENTRAL STATION METER DEPARTMENT.

By A. J. Cridge, Sheffield.

*(Abstract of paper read at Derby, June 29th, 1904.)*

The object of this paper is to outline some of the methods adopted in the equipment, maintenance and working of a meter department in connection with an electricity supply undertaking.

The test room should be provided with sufficient shelves for storing meters; nothing is worse than to have meters on the floor or piled upon each other.

There should be plenty of spare bench room, and a small vice attached to the bench is very handy.

*Work in Connection with Meters.*

For the purpose of controlling the supply of electricity for testing, a switchboard will be required. The one here described controls a maximum supply of 10 KW., *i.e.*, 50 amperes at 200 volts single-phase alternating current. By means of a suitable transformer it is possible to get almost any voltage from 28 to 300 by altering the connections. This is done by causing the turns on the secondaries of the transformer to help or to oppose each other. Similarly it is possible to get any current up to 300 or 400 amperes.

The link connectors of the transformer, therefore, give a coarse adjustment, and the fine adjustment is made by means of suitable rheostats. The voltage is measured by Kelvin voltmeters, the current by Kelvin ammeters, and the wattage by a Kelvin balance.

There are six main circuits which branch off from the switchboard, as follows:—(1) experimental; (2) rheostat (large); (3) rheostat (small); (4) meter bench (i); (5) meter bench (ii); (6) main coil of Kelvin balance. These are put in or taken out of circuit by plugs, and the ammeters are connected by plugs with flexible conductors attached

There are twelve pressure circuits provided, six on either end of the board. Only four of these are in use on one end, and three on the other. They are as follows:—

I.—(1) meter bench (i), top shunt circuit; (2) meter bench (i), bottom shunt circuit; (3) experimental; (4) photometer.

II.—(1) meter bench (ii), top shunt circuit; (2) meter bench (ii), bottom shunt circuit; (3) shunt of Kelvin balance.

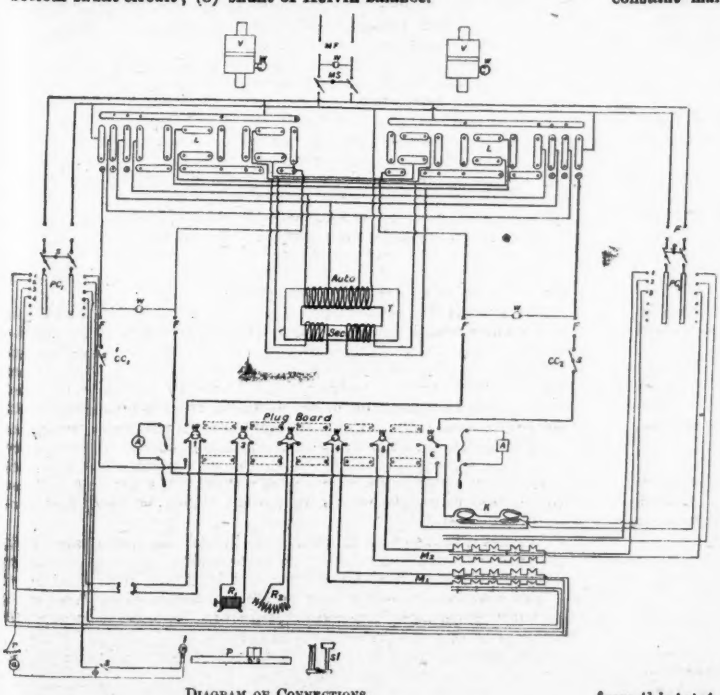


Diagram of Connections.

M F, Main fuses; M S, Main switch; V V V, Voltmeters; W, 2-pin plugs; L L, Link connections; T, Transformer; Auto, Primary of transformer with tappings; Sec., Secondaries of transformer; C $C_1$, C $C_2$, Current circuits; P $C_1$, P $C_2$, Pressure circuits; 1, 2, 3, &c., Sub-circuits; $R_1$, $R_2$, r, Rheostats; A A, Ammeters; P, Comparison box of photometer; *l*, Lamp under test; *s l*, Standard light; *s*, Switch; *f*, Fuse; Plug board, 1, 2, 3, &c., Circuits from plug board; K, Kelvin balance.

Two-pin plugs are placed across each of the main circuits for the purpose of measuring the pressure between any pair of circuit leads, or absorbed in any piece of apparatus. The use of the main circuits is:—

1. *Experimental.*—A pair of heavy cables run to a pair of big terminals on a bench. The current and the pressure can be adjusted to any figure desired, so that the circuit may be used for any purpose.

2. *Rheostat* (large).—This is for the control of currents up to 125 amperes. It consists of carbon plates, and the resistance is increased or diminished by slackening or tightening a screw.

3. *Rheostat* (small).—This is for the adjustment of small currents, from ·1 to 5 amperes.

4 and 5. *Meter Benches.*—These are arranged to hold a total of 48 meters. The meters are placed in position on the bench, and the series coils are disconnected from the shunt coils. The series coils are then connected to terminals on the bench by flexible connectors, and the shunt coils joined across the proper pressure circuits by small flexibles, to which are attached two-pin plugs.

Attention has been given, in the design of these benches, to the need of fixing up a number of meters for testing in the most expeditious manner possible. All connections are made by plugs or clips. To join up any terminals not in use, copper bridge-pieces are employed.

6. *Main Coil of Kelvin Balance.*—The balance shunt coil is disconnected from the current coil, and the latter, which constitutes circuit 6, is plugged in series with the meter benches and rheostats. The shunt coil is connected across pressure circuit II., sub-circuit 3.

The use of the pressure circuits is almost obvious. On circuit I., the first two sub-circuits are for the shunts of meters connected to the top or bottom racks of meter bench I.

The third sub-circuit consists of a pair of leads which run to two terminals on the working bench, and to which may be connected any apparatus which does not take very much current. The most frequent use to which it is put is that of running incandescent lamps which are undergoing a life-test. Sub-circuit 4 belongs to the photometer.

On circuit II., the first two sub-circuits supply the shunts of meters on meter bench II., and the third is the shunt of the Kelvin balance.

The testing of meters is carried out as follows:—A number of meters having been joined up in series on the benches with their series coils disconnected from their shunt coils, the current flowing through them is adjusted by means of the rheostats and measured by the balance. A few revolutions of the disk are observed, and the time taken is noted by means of a chronograph. The testing constant of the meter being known, the percentage accuracy can be calculated from these observations.

The practice seems to be becoming general among meter makers of constructing all their meters in such a manner that the disk revolves a certain round number of times per minute at full load. Thus Ferranti meters make 40 r.p.m. at full load, Westinghouse and Schuckert 50, Electrical Co. 60. Other makes of meters have a constant marked on the dial, giving the number of watts which cause the disk to make one revolution in an hour. Thomson meters form a well-known example of this kind.

Any induction meter which is suitable for inductive as well as non-inductive load is usually good.

The day of meters with commutators is over; there are now so many good types of induction meters which are greatly superior if only for this reason.

The Aron meter is good, but the winding gear has been found to give a lot of trouble on alternating current circuits; the contacts get dirty because of the sparking which takes place so frequently.

Some meters are now constructed with cyclometer dials, and most manufacturers are willing to supply their meters fitted in this way. These are infinitely to be preferred to the old type; the possibility of error on the part of the meter reader is entirely eliminated, and consumers like them, because they are easier to read, and they are thus enabled to check their consumption.

The meter, after being tested and adjusted, is sent out to an installation. The meter reader has to note the reading of the old meter, take out the fuses, take down the old meter and fix the new one, replace the fuses, note the reading of the new meter and try it for starting with an 8-C.P. lamp. If it is a new installation he has not to put in the fuses nor to try the meter, this being the duty of the testing inspector.

The maintenance of the station meters is an important matter, and they should receive frequent attention. It is useful for many reasons to know the total number of units generated; the works cost, percentage of waste, &c., are all determined from this total. A small error in large meters such as these makes a lot of difference.

Demand indicators are not in use at Sheffield, but for the purpose of testing these the indicators would be connected in series and set to zero. The required current would be passed through them for 30 or 40 minutes, and readings would be taken. The necessary adjustments would be made from these observations.

*General Testing.*—Any instrument which needs testing is connected across the experimental circuit in series with a rheostat and a standard instrument, and comparisons are made at a number of points in the range. No detailed description of this work is necessary.

A Wheatstone bridge is the best thing to use for testing resistances. The Vulcan ohmmeter is a cheap and useful instrument, the range being from ·1 ohm to 20 megohms, and the method of using the instrument is the same as with the bridge.

It is very useful to be able to test the candle-power and wattage of lamps, and to know the best lamp to recommend for consumers' use. One of the pressure circuits is in use for this work. A voltmeter, ammeter and rheostat are connected on this circuit, together with the lamp to be tested. The standard light is a Simmance's 1-C.P. pentane lamp, and the comparisons are made on a direct-reading scale by means of a Bunsen disk. The photometer should be constructed for use in a light room, as space cannot often be spared to build a dark room.

The lamps are put on for life test in a bank constructed to hold 25 at a time. Tests of the candle-power, &c., are made at intervals of 24, 100, 250, 500, 750 and 1,000 hours. The reason for the test at 24 hours is that some lamps increase in candle-power after they have been running a little while.

When appliances for use in consumers' installations are submitted for examination, tests are made under both normal and abnormal conditions. For switches, fuse-boxes, &c., the abnormal conditions are to operate on double their stated capacity at double the proper pressure.

The testing of time switches, prepayment devices, &c., may be placed in this division. The few prepayment meters in use in Sheffield are of the Vulcan type, 1d. in the slot, which have proved quite satisfactory.

*Work in Connection with Consumers' Installations.*—It is difficult to make a thorough inspection of a completed installation; consumers naturally object to having floor boards lifted, capping taken off, &c., when the job has been finished off. It will, therefore, be found advisable for the testing inspector to visit new installations while actually being wired, when joints can be examined, samples of cable can be taken, the methods adopted for laying concealed wires can be inquired into, and any other examination can be made.

After the inspection referred to above, very little remains to be done except to test the insulation resistance to earth and between leads.

Main fuses of the proper size are then put in, the main switch is turned on, and all the lamps and other consuming devices are tried to see if they are in working order. The inspector should also try the meter for starting before leaving the job.

It will be found convenient to test the amperes on the distribution circuits for a final check. It is not always easy to find the exact number of points on a circuit before the job is completed. For this purpose any small ammeter may be used; one of the watch pattern, reading up to 5 amperes, is sufficient for installations of incandescent lamps.

In the case of a complaint of poor light, it will be advisable in most cases to send up and see if it is possible to advise the consumer to make any little alterations to the distribution of his lamps, or to put in new lamps. This, of course, is in addition to taking pressure tests.

It is necessary to send a capable and tactful man on work of this kind.

Extinctions may be attended to by meter readers, as they are generally due to a fuse having blown for some reason.

The meter reader is not allowed to increase the size of the fuse, and thus neither can extensions be connected nor faults burnt out by the insertion of an excessive fuse.

During the evening, fault work is attended to by the mains department.

*The Commercial and Clerical Side.*—Dial cards are used for taking the readings of the meters.

The monthly reading takes about 10 days. It is commenced every fourth Monday, so that there are 13 readings in the 12 months. Entering the readings up and settling the queries takes about 14 days. The readings are entered on account cards. The cards are arranged in the most convenient order for reading, and the town is divided into districts.

Four men are engaged meter reading, and these follow each other on the different circuits every month: thus in January, A would take circuit 1, B circuit 2, &c.; in February, A would take circuit 2, B circuit 3, and so on. In this way each inspector checks the man who preceded him and the perpetuation of errors is avoided.

If the clerk considers any reading doubtful, he notes the name and address of the consumer, with the suspected nature of the fault, and the foreman meter reader examines the meter, checks the reading, and decides whether or not the meter should be changed and tested.

When all accounts are entered up and queries settled, the cards are sent down to the general office, where the invoices are made out and the ledgers entered up.

For keeping the records of consumers' installations, cards are used giving full particulars.

It is almost impossible satisfactorily to keep meter stock records in books; it is better to use cards giving a description of the meter, written along the top of the card, and, below, the movements of the meter are set forth, with dates against them.

The tests made should be immediately entered in a day-book, and with the aid of the date shown on the card it will not be difficult to find any desired test.

It is advisable to charge consumers' meters at intervals not exceeding two years. A convenient method of keeping up the proper rotation is to use a meter-changing card, ruled on one side, and giving particulars of consumers' name, address, district, pressure of supply, type, constant, size, and date fixed of the meter. This card should then be placed behind a guide card showing the same month two years ahead.

The balancing of the three-wire low-tension network is in the charge of the meter superintendent, and, to keep this correctly, recorded cards are used, showing the consumer's name, address, demand, polarity, and time of extinguishing.

A "totals" card is put at the beginning of each street or section of a street, and this indicates the state of the balance on any particular section at a glance.

The card which is left on the consumer's premises is ruled in three columns, for date, reading of meter, and inspector's initials. It is made to fold double, and on the outside are placed the consumer's name and address, the number and size of the meter, and its constant for units. There are also a few printed notices and instructions for consumers.

The books used in the meter department need not be many. For the use and direction of the workmen three books are needed. They are:—

1. The work book, in which particulars of fuse replacing, special meter readings, disconnections, re-connections, &c., are entered.

2. The meter-changing book, in which particulars of all meter changes are recorded: and

3. The inspector's report book, in which workmen report any remarks made to them by consumers, any defects in meters or other apparatus, or any similar matter.

The installations connected are entered in a day book known as the "Watts Wired Book." This book merely shows the name and address of the consumer, the distance in miles from the station, the wiring contractor, the consuming devices connected or disconnected, and the date. For noting particulars of installations, the testing inspector carries a pocket-book with the necessary headings printed in it.

It is the duty of the meter department to attend to consumers' complaints of accounts. This is rather a delicate matter at times.

If the meter is apparently correct, the consumer is asked if he will agree to pay the expense of testing if found so, while the Corporation make no charge if the meter is found to be inaccurate. This is, however, a rule which it is often advisable to break through, to conciliate consumers.

It is also advisable to see if the consumer cannot economise by rearranging his installation.

Consumers who use a large amount of power frequently apply for a reduction in the price per unit, and this may often be profitably given.

The calculation involved is simple. Taking the total units during a year, divide by 365; the result is the units used per day. Dividing this by the maximum number of kilowatts demanded, the number of hours per day during which the demand is maintained is found. The price to be charged may then be worked out on any two rates, such as 7d. for the first hour and 1d. afterwards. This is, of course, the maximum demand system without the demand indicator.

The allocation of wages, &c., is done weekly. It is well to have as few accounts open as possible.

Most wages are covered by the four accounts—meters, capital and maintenance; and testing, capital and maintenance. Tools and instruments are charged in separate accounts.

It is important to see that good meters are bought when a purchase is made. Whenever the superintendent of a meter department, or the manager of a supply undertaking, comes across a meter with which he is not familiar, he should at once endeavour to obtain one for testing. Manufacturers will always send if the user undertakes to buy the instrument if satisfactory.

The staff of the Sheffield meter department consists of:—Meter superintendent; testing inspector and boy; chief clerk, two junior clerks and office boy; foreman meter inspector; meter tester; four meter inspectors; relief man—a total of 14 individuals.

The system of interdepartmental working is worked from the general office by means of the "ticket book." The operations in connection with this book are the following:—

The intending consumer signs the application form, and the clerk in the office writes the first ticket, giving particulars of the application. This is sent to the meter department, the polarity, voltage and number of service lines to be installed are decided, and the counterfoil is sent back to the office. At the same time a ticket is issued from the general office to the mains department, directing it to prepare plans, &c. The third ticket to be written is sent from the general office to the mains department, and contains instructions to lay the service as decided above. When the service is laid, the counterfoil is sent to the office, which then sends out instructions to the meter department to fix meters. This is done, and the counterfoil returned.

When the contractor's test notice is in and the meters are fixed, instructions to test and connect are sent from the office to the meter department, and when the job is completed the final particulars of the service are sent to the drawing office. Additions are dealt with in a similar way, and thus the necessity of allowing the consumer's application to go out of the office is avoided.

This system has been employed at Sheffield for nearly four years, and has been found satisfactory.

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The discussion which ensued was comparatively short, and was opened by Mr. J. A. CHRISTIE (Brighton) who expressed the opinion that meter departments were frequently neglected and probably could account for many of the missing units. The card system mentioned by the author had been in use at Brighton for some time.

Mr. J. R. DICK (Reason Manufacturing Co.) emphasised the greater value of the units saved at the meter as compared with any saving in the works—the former bore the full selling value while the latter were of the order of 6d. to 8d. per unit. He thought it of great importance to obtain meters with high permanent accuracy; the great percentage of meter errors was in meters reading slow, and this entailed a serious loss.

Mr. W. A. CHAMEN (Glasgow) considered that cyclometer dials

were a great improvement, but they could not be easily obtained. From the paper he gathered that there were two distinct classes of men dealing with meters at Sheffield, which was a variation from the usual practice. In Glasgow they had distinct meter readers in connection with the commercial department. He had refrained from using penny-in-the-slot meters, owing to the adverse experience of the gas department with them at Glasgow.

Mr. J. H. Cawthra criticised the period of two years for a meter to remain fixed as exceedingly short, the staff also appeared very large for the number of meters employed, and

Mr. J K Brydges pointed out a statement by the author, which, he thought, advocated preferential charging.

Mr. G. Wilkinson also considered the staff excessive. In Harrogate, with 1,300 meters, they had one tester, two boys and a reader.

Mr. A. J. Cridge, replying briefly, explained that the duties of the Sheffield meter department covered far more than attention to the meters—they fixed and read them, also making out the accounts for the customers—this constituting the variation from the usual practice.

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## SOME NOTES ON THE BRISTOL ELECTRICITY WORKS FIRE.

By H. Faraday Proctor, City Electrical Engineer, Bristol.

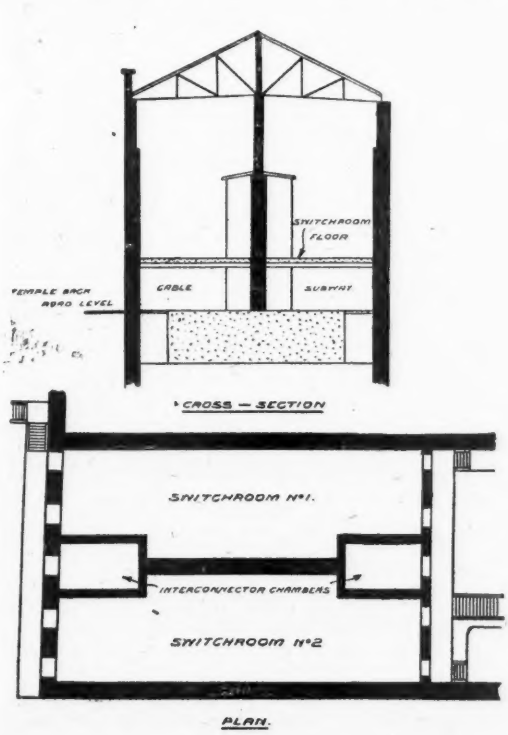
(*Abstract of Paper read at Nottingham, June 30th*, 1904.)

At the request of the Council, the author contributed these notes with the view of affording an opening for considering the possibilities of electricity works fires in general, and the Bristol fire in particular.

As the facts relating to the latter have already been published in the Electrical Review and elsewhere, they need not here be recapitulated.

The remains of the old board were very carefully examined, and several consultations were held to endeavour to ascertain the source of the breakdown, but there was not sufficient evidence to point conclusively to special features constituting the primary cause.

It was most improbable that a fault on the external system was to blame, since all of the trunk mains and feeders were protected by fuses, and, some minutes after the arc was formed, the ammeters registering the entire output from the Temple Back Works were examined, and showed a normal current. After the fire, it was found that one of the trunk mains, which remained loaded to the last, had fused for a length of about 3 to 4 ft. in the ground outside the Temple Back Works; but, as the arc had apparently sufficient resistance to keep the current within the limits of the fuses at the Avonbank end, these did not operate.




Sectional Elevation and Plan of New Switchrooms.

It would appear that the origin of the trouble is to be found from amongst the following:—

First, by leakage from the metal work of the board "charged at high pressure" over the surface of the insulators and slate to "earth," or, in other words, to the other pole of the board, in which case it is further possible that this may have been, in a measure, caused by the presence of moisture, or by a crack in one of the insulators due to the jar of operating the switch.

Secondly, by the breakdown of one of the cable receivers, in which the cables from the machines to the switchboard are jointed up In the event of such a fault occurring, however, it is most probable that, owing to the proximity of the two conductors, a "dead short" would have resulted, causing the engine to pull up, the mass of metal being too great to allow of the fault clearing itself, and the machine fuse would have operated, due to the current from other generators. Since the machine in question did not pull up, and since the fault was not a dead short, as evidenced by the fact that the load on the Avonbank station did not run up to more than about 1,374 amperes, viz, say 200 amperes above the normal load for the time in question, it appears that the fault did not originate at the cable receiver.

Thirdly, by the abnormal action of one of the machine fuses, the blowing of the fuse causing an arc and breaking the porcelain pot filled with oil in which the fuse is placed.

Although some engineers, who have examined the board since the accident, seem to favour the opinion that the improper action of the fuse was the first cause of the trouble, none of the members of the staff hold that view.

It is very certain, however, that when once the fault commenced, the whole of the cause of the spreading of the trouble was attributable to the oil used in the fuse holders and switches, of which there would be about 22 gallons.

The cables contributed largely to the flames, although they were all encased in lead and further protected with steel armouring. The steel armouring, however, was served over with impregnated jute, and this getting soaked with oil was of course very inflammable.

In reconstruction it has been considered desirable to avoid:—

1. The use of oil in porcelain holders.

2. The use of wood anywhere about the structure of the switchboard floors, unless it is in such form as to be proof against fire. Hardwood blocks set upon a concrete foundation probably form the best and safest description of switchboard flooring as, whilst it is practicably unburnable, it affords a good insulation from an electrical point of view, and does not appear to be open to the objections that have been found to exist in the case of glass.

3. Cables, although armoured with lead or steel armouring, must be further protected by being either buried or run in metal casings; and

4. The roof must have in its construction no wood, unless it be thoroughly protected, as in the construction of fire-proof doors.

Ferranti switchboards of the type whereon the accident occurred have been very generally accepted as being of the most suitable form for use under the particular conditions of the Bristol system, but it seems imperative that boards constructed on this principle should not be built into any external wall of a building, for, although the walls of the generating stations at Bristol are formed of most excellent bricks set in cement and are 2 ft. thick, there is no doubt that with continuous wet weather and strong winds, damp has found its way through and the back slates supplied with the board afford no protection. A drawing of the proposed fireproof switch rooms is given herewith.

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Mr. M. H. Kilgour, in opening the discussion, suggested that a great deal might be learnt from such incidents as the Bristol fire, if only they were more frequently brought forward. His opinion was that the seat of the trouble was at one or other fuse on the machine panels. From experience, fuse springs and strips became stiff, and this prevented their prompt action. The Ferranti type of board was convenient to work, but, in his opinion, the oil-break fuses ought to be replaced by overload switches, &c.

Mr. G. H. Cottam was somewhat sceptical as to whether the oil-pots were full of oil, or were properly examined; in his experience, empty oil-pots had fused up.

Mr. Leonard Andrews thought it hardly probable that the trouble originated through surface leakage; he considered that an arc was started through the interruption of a circuit causing a heavy current, probably in a fuse, and that the original cause of the abnormal current lay in a failure of the insulation on a feeder. Fuses were never absolutely reliable in his experience, and we must do away with them wherever possible, substituting circuit-breakers.

Mr. C. H. Wordingham emphasised the necessity for incombustible construction of the board and gallery. In regard to cutting off the Avonbank supply suddenly, it was a serious matter to shut down with full steam on, and to overcome this he had provided in a large installation, valves on the steam pipes to open them practically full bore to atmosphere in case of emergency.

Mr. H. W. Clothier reiterated the opinions contained in his report made after the fire. The oil in the switches was an excellent insulator, and had a high flash point. He thought that if the stop valves of the engines had been shut promptly the fire effects would have been quickly overcome.

Mr. G. Wilkinson expressed the opinion that the subject was still shrouded in mystery. He believed that in the 2 or 3 minutes elapsing after the arc started, the attendant might have extinguished it, if the platform had not been so narrow. The Ferranti board was still quite reliable up to 2,000 volts pressure.

Mr. S. Z. de Ferranti was of opinion that it was a case of fuse failure pure and simple, nothing extraordinary having occurred. Many patterns of this type of fuse were in use, this one was

supposed (apparently erroneously) to be an improved pattern. He thought that, in conformity with the opinion of other speakers, the spring failed, and the fuse was not immersed in the oil—burning oil and molten metal were thrown out and ignited the switchboard platform, and this was certainly the cause of the whole board being burnt out. He considered that the cellular pattern of switchboard was still the most reliable for limiting damage, but it was also necessary to eliminate all combustible matter near the board. He did not like the lids provided on the fuses, but users having bought them would not discard them, and they were some protection against dust. The fuses in question were very well adapted for the work for which they were originally introduced, but for the larger work and higher voltages of to-day, better results were obtained by using oil break switches and circuit breakers. He believed that the oil, as used at the present day, was very reliable and suitable for its purpose.

Mr. Faraday Proctor, in replying, discredited the idea that the fuse pots were not in thorough working order at the time of the accident. They were going to put in circuit breakers in the new board. The cables were burnt by fire and not electrically. He also pointed out that the bulk of the energy coming from Avonbank was passing out by the feeders at the time of the failure of the machine panel.

## TRAMWAYS AND COMPULSORY RUNNING POWERS.

By THOS. UPTON.

The decision of the Parliamentary Committees to grant to a public company compulsory running powers over a portion of a certain municipal tramway has caused this question to become one of pressing moment, and the time has undoubtedly arrived when it becomes necessary to examine the whole question very fully.

It can be readily understood why municipal and other local authorities owning such undertakings are greatly disturbed at the prospect of being compelled to grant running powers over their systems to private and other similar companies, and are "up in arms" against the innovation thus inaugurated, although at the same time it is very hard to see why tramways which are constructed, as local authorities admit, for the convenience of the public, and which are strong competitors with private enterprise, should stand in the way of their ratepayers and travelling public residing within their areas, enjoying the benefits of through running and booking on to lines belonging to other local authorities or companies adjoining, and in many instances physically connected with their own systems.

In this, at any rate, they do not study the interests of their residents, and without doubt cut away the very ground of one of their strongest arguments in favour of localisation, striking a severe blow at municipal trading. The public care little and trouble less as to the pros. and cons. of such a controversy, they expect to have—to my mind rightly—and will press matters until they do get, every natural facility that presents itself, for cheap, quick, and convenient travelling; therefore the sooner local authorities recognise the fact that the public detest and resent the inconvenience of being discharged from one and forced to change into another car at urban, suburban, or other civic (but equally to them unmeaning) boundaries, and proceed on lines that are legitimately required by the public, the better it will be for every one concerned.

I cannot help thinking that a great deal of the opposition to through running powers over tramway systems is caused by lack of knowledge of this important subject, brought about almost entirely by the appointment to the management of such undertakings of persons who have little or no knowledge of such a subject, not having had the necessary commercial training to equip them for such positions, which, without doubt, require an intimate knowledge of the "carrying" business in general, such as can only be obtained by years of experience in railway working. What railway company would for a moment entrust its commercial and inter-working arrangements to anyone, without the proper training with a good commercial knowledge of the requirements of the traffic to be catered for, intricate through workings, and a host of other matters, unless it were riding for a fall, to say nothing of the trouble and interference on behalf of the public by the Board of Trade, and possibly Parliament itself, that would inevitably follow?

It cannot be contended that there is no precedent for such running powers being granted even in the tramway world, but even providing there were no such precedent, surely the idea could never for a moment have been entertained that the time would never come, when through runnings and bookings of passengers, to say nothing of merchandise, would be the order of the day, particularly in view of the great and widespread development of tramways in rural districts, linking up as they were intended to, large and populous towns and districts. The very development of such undertakings made it imperative that at an early date through working arrangements would become necessary, and an accomplished fact, no matter what steps local authorities might take to postpone or nullify such conveniences to the public generally.

It may possibly be said that the advent of through cars into large towns, with quick services and considerable mileage, would cause inconvenience to the public within its area; this, to my mind, appears to be a very flimsy argument. The fact must not be lost sight of, that the greater number of such through passengers would be on business bent, and very frequent travellers, therefore the inconvenience assumed would be nothing of the kind, inasmuch that the tramway authority would in the ordinary course have to provide cars within its own area to carry the same passengers. Yet, in all probability, through cars would in many instances be of considerable assistance during the periods of the heavy daily traffic, by reason of the purely local cars being less congested, and therefore more convenient to the local residents. I am also strongly of opinion that there should not be any very great difficulties to overcome in the timing and working of through cars over two or more systems, providing arrangements are come to on a proper and equitable basis, with a desire to meet the demands of the traffic in a fair and conciliatory spirit, without each party endeavouring to get the better of the other.

Again, it may be said that the varying cost of power on systems forming sections of through routes would constitute a serious drawback to the development of through runnings and bookings, but here again I fail to see any legitimate reason for such a contention. It does not follow that through workings and bookings would necessitate, or even be the means of or cause the reduction of, through fares below the sum of the several local fares, just as frequently happens in railway through workings and bookings, the through fares being the sum of the several local fares; consequently the receipts accruing to each separate undertaking, parties to through running, would be exactly the same as when local runnings and bookings only were in operation. However, if reduced fares were deemed advisable, it would be proper for each party or undertaking to study its own cost of production, &c., and reduce on its local fare only, so that the balance of earning power would still remain in ratio to the original receipts on each separate section.

In the matter of "leased" lines, there would be no further difficulty, although it would be the better policy for the working authority or company to pay a fixed percentage of gross receipts to the actual owners, based on the system adopted by railway companies, retaining the residue to themselves for working expenses and profit, leaving the owning authority or company to pay out of their fixed proportion, certain specified charges, including interest and capital, depreciation and renewal charges, rates, taxes, &c. In railway working the amount usually allowed out of the gross receipts by the lessees to the lessors is $33\frac{1}{3}$ per cent. thereof.

A point yet to be considered is the manning of through cars, and the amount to be paid to the parent company or authority for the use of such cars on foreign systems. It is obvious a payment must be made; it would not be a fair and equitable arrangement that because cars run on to other systems which get the use of them, and *vice versâ*, payments should fall out of the question, particularly in the case of a heavy traffic system joining with a light traffic system, which would furnish in the greater majority of cases "through" traffic only.

Personally, I very strongly incline to the opinion that the drivers and guards of the parent company should work their

own cars through to destination, having specially trained men for the purpose, and that a fixed sum per passenger carried through, or picked up "locally" on the journey over "foreign" systems, where two companies or authorities only are concerned, should be paid to the car's parent system, irrespective of distance or fare collected, and not so much per car-mile of the receipts; further, that an equal number of cars should run "through" in each direction daily, thereby keeping up the full quantity, and regular cars running continuously on each system, just as though the traffic were being dealt with on a local basis only.

In the case of three or more separate undertakings being parties to a through running and booking arrangement, this system would require to be somewhat modified, and possibly a scale of mileage proportions per passenger might be instituted in cases where the cars of the intermediate undertaking do not cover the mileage, or participate equally with the undertakings working through from either end.

There would be no difficulty in keeping proper records by drawing up a fixed scale of allowances according to the tickets issued, and by the use of daily abstracts, to which I will refer later.

There is certainly considerable difficulty in the drawing up of tickets to cover the requirements of through working, and issuing them to conductors for use on through cars, owing to the number of such tickets it would be necessary to issue, and for the conductors to carry over and above the ordinary tickets required for use locally on each system. I do not for one moment consider it necessary, or that it would be entertained, for a conductor to carry anything like a corresponding number of "through" to "local" tickets, and I have no hesitation in saying it is a difficulty that can be readily surmounted, after making full allowance for the inconvenience of overlapping stages and fares, if, as I have previously said, reliable, smart, thoroughly trained conductors are kept on the cars, and on their regular routes.

It may yet be urged that the system of accounts adopted by tramway and light railway companies would not be suitable for that necessary to through bookings and workings; further, that to carry out the idea into actual practice would entail the employment of a separate and independent staff, with, possibly, an independent manager, to deal with the question of accounts, divisions of receipts, &c., thereby adding very considerably to the working cost. This is a fallacy easy of disposal, for, as a matter of fact, no extra cost on this account, at any rate, need be entailed, beyond the supply of properly designed abstract forms to be adopted by all undertakings parties to the arrangements, and to compile which daily would not, on the busiest of days, add, at the very most, 30 minutes' actual work to that already done by the ticket-issuing staff, and could, without the slightest effort or difficulty, be brought into the ordinary day's work. Therefore, as no extra staff would be required, or a special department created, it follows that no extra management or clerical cost would be required by the adoption of through booking and running of passenger traffic. The abstracts, which should follow as nearly as possible those in operation by the railway companies, would be made out by each undertaking party to the arrangement for through booking and running daily, and, at the end of each month, totalled, showing each day in detail the tickets issued, amount received for same, and proportion payable to each authority or company, the latter exchanging a copy of its abstract each month, from which it would be able to check and ascertain the amount to be paid by the issuing undertaking; each would then collect its own share from the other, taking, as I would suggest, receipts in full, and not by means of "contra" accounts, there simplifying the book-keeping, and at same time showing the transactions in full, with corresponding receipts for audit purposes.

In America, to which, perhaps, it will be suggested we should turn for some basis upon which to found the fabric in this country, seeing they have had, for many years past, this matter of "through" running in operation, it will be found that this subject is in just such an unsatisfactory state as here. In some instances the companies take over the cars at their boundaries, furnishing therefrom the necessary motormen, conductors, and power, collecting all fares at the regular rate for all passengers on their system; a rental for the use of the car, varying from two cents per car-mile to a proportion of two-fifths of all fares collected from passengers while in their possession (records being made of the state of the fare registers at the various boundaries), is paid by the operating to the owning company. In yet other instances one-half of the fares collected by the operating company is allowed to the owning company of the car in the case of through working, the records being taken as previously stated. Even in America the arrangements do not appear to be on uniform lines, and it is quite evident agreements as to running powers have not yet been put on a proper and lasting basis.

In connection with this question it might be as well to quote certain clauses of various Acts of Parliament bearing on the question of through bookings and workings of traffic on railways, which will without doubt be brought to bear, and form the basis of any action that may be taken by the Legislature in dealing with this question in connection with tramways and light railways.

Sec. 87. Railway Clauses Act, 1845, provides that:—

It shall be lawful for the company from time to time to enter into any contract with any other company, being the owners or lessees or in possession of any other railway, for the passage over, or along the railway by the special Act authorised to be made of any engines, coaches, wagons, or other carriages of any other company, or which shall pass over any other line of railway, or for the passage over any other line of railway of any engines, coaches, wagons or other carriages of the company, or which shall pass over their line of railway, upon the payment of such tolls and under such conditions and restrictions as may be mutually agreed upon; and for the purposes aforesaid it shall be lawful for the respective parties to enter into any contract for the division or apportionment of the tolls to be taken upon their respective railways.

Sec. 88 reads:—

Provided always, that no such contract as aforesaid shall in any manner alter, affect, increase, or diminish any of the tolls which the respective companies, parties to such contracts, shall for the time being be respectively authorised and entitled to demand or receive from any person or any other company, but that all other persons and companies shall, notwithstanding any such contract, be entitled to the use and benefit of any of the said railways upon the same terms and conditions, and on payment of the same tolls, as they would have been in case no such contract had been entered into.

Sec. 90 reads:—

And whereas it is expedient that the company should be enabled to vary the tolls on the railway so as to accommodate them to the circumstances of the traffic, but that such power of varying should not be used for the purpose of prejudicing or favouring particular parties, or for the purpose of collusively and unfairly creating a monopoly, either in the hands of the company or of particular parties. It shall be lawful, therefore, for the company subject to the provisions and limitations herein, and in the special Act contained, from time to time to alter or vary the tolls by the special Act authorised to be taken, either upon the whole or upon any particular portions of the railway as they shall think fit; provided that all such tolls be at all times charged equally to all persons and after the same rate, whether per ton per mile or otherwise, in respect of all passengers, and of all goods or carriages of the same description, and conveyed or propelled by a like carriage or engine passing only over the same portion of the line of railway under the same circumstances; and no reduction or advance in any such tolls shall be made either directly or indirectly in favour of or against any particular company or person travelling upon or using the railway.

Sec. 91 reads:—

And whereas authority has been given by various Acts of Parliament to railway companies to demand tolls for the conveyance of passengers and goods and for other services over the fraction of a mile equal to the toll which they are authorised to demand for one mile; therefore, in cases in which any railway shall be amalgamated with any other adjoining railway or railways, such tolls shall be calculated and imposed at such rates as if such amalgamated railways had originally formed one line of railway.

Part III.—Railway Clauses Act, 1863, Sec. 22, provides that:—

Where two or more companies are authorised by a special Act hereafter passed and incorporating this part of this Act, to agree among themselves with respect to all or any of the following purposes, namely:—

The maintenance and management of the railways of the companies respectively, or any one or more of them, or any part thereof respectively, and with the works connected therewith respectively, or any of them;

The use and working of the railways or railway, or of any part thereof, and the conveyance of traffic thereon;

The fixing, collecting, and apportionment of the tolls, rates, charges, receipts, and revenues levied, taken, or arising in respect of traffic;

Then and in every such case the authority so to agree, or the agreement when entered into shall not in any manner affect any of the tolls, rates, or charges which the companies parties thereto are

from time to time respectively authorised to demand and receive from any person or from any other company; but all such persons and companies shall, notwithstanding the agreement, be entitled to the use and benefit of the railways of the several companies, parties to the agreement, on the same terms and conditions and on payment of the same tolls, rates, and charges as they would be if such authority had not been given or the agreement had not been entered into.

Sec. 23 provides for "The Sanction of Shareholders to Agreements."

Sec. 24 provides for "Public Notice of Intention to Enter into such Agreement" in each of three successive weeks in some newspaper published or circulated in the county prescribed in the special Act.

Sec. 25 provides that :—

"The agreement shall not have any operation until it is approved by the Board of Trade, and the Board of Trade shall not approve the agreement without being satisfied of its having received such sanction of meetings of the respective companies as aforesaid.

By the Railway and Canal Traffic Act, 1888, Part II., Sec. 25, "Provisions as to through traffic," it provides after quoting Sec. 2 of the Railway and Canal Traffic Act, 1854, that :—

Subject as hereinafter mentioned, the said facilities to be so afforded, are hereby declared to and shall include the due and reasonable receiving, forwarding, and delivering by every railway company and canal company, and railway and canal company, at the request of any such other company, of through traffic to or from the railway or canal of any other such company at *through* rates, tolls, or *fares* (in this Act referred to as through rates), and also the due and reasonable receiving, forwarding and delivering by every railway company and canal company, and railway and canal company, at the request of any person interested in through traffic, of such traffic at through rates. Provided that no application shall be made to the Commissioners by such person, until he has made a complaint to the Board of Trade under the provisions of this Act as to complaints to the Board of Trade of unreasonable charges, and the Board of Trade have heard the complaint in the manner herein provided.

Provided as follows:—

1. The company requiring the traffic to be forwarded shall give written notice of the proposed through rate to each forwarding company, stating both its amount and the route by which the traffic is proposed to be forwarded; and when a company gives such notice it shall also state the apportionment of the through rate.

2. Each forwarding company shall, within 10 days, or such longer period as the Commissioners may from time to time by general order prescribe, after the receipt of such notice, by written notice inform the company requiring the traffic to be forwarded whether they agree to the rate and route, and if they object to either, the grounds of the objection.

4. If an objection to the rate or route has been sent within the period prescribed, the matter shall be referred to the Commissioners for their decision.

7. If the objection be only to the apportionment of the rate, the rate shall come into operation at the expiration of the prescribed period, but the decision of the Commissioners as to its apportionment shall be retrospective.

There are many other Acts of Parliament which have been passed in connection with railways, containing clauses that would doubtless have direct bearing on the question, but I think sufficient have been quoted for the purpose in view.

## REVIEW.

*The All Red Line: The Annals and Aims of the Pacific Cable Project.* Edited by GEORGE JOHNSON. Ottawa: James Hope & Sons. 1903.

So little has been written or said regarding the all-British Pacific cable since it has become a reality, that a recent book on the subject, by Mr. George Johnson, forms a matter of some interest. This book constitutes a curious mixture. It is, on the one hand, a sort of unofficial condensed blue-book regarding the gradual evolution of the scheme, forming a record of the correspondence, conferences, and main evidence, &c.; and, on the other, it professes to give an account of the work as realised, using technical terms (such as "K.R."), which the writer may, or may not, understand, but which in a book of this description—apparently intended largely for the general public—certainly need fuller explanation.

In this work the editor reproduces lengthy extracts from letters and articles which have from time to time appeared in the Press on the subject, and in some cases these appear practically at full length. He occasionally also introduces his own views—though at far less length—and it is, in certain instances (owing to the general arrangement of the book), difficult to recognise where he is quoting and where the views are "off his own bat." This is notably the case in his chapter on "State Partnership in a Cable System," wherein—by way of argument—he quotes in turn, from Plato, Cicero, Sir George Cornewall Lewis, Sir Sandford Fleming, Gibbon's "Decline and Fall of the Roman Empire," Leroy-Beaulieu, M. Gide, Prof. Richard Ely, Laurence Gronlund, and Sir Frederick Pollock. The first part of this chapter ends up: "It is submitted that a fair reading of authority, both in law and political economy, will lead to the conviction that the electric cable is a proper subject of State ownership."

The second part—which is the essence of the whole book, in so far as originality goes—professes to present the view of "the man in the street," and here we have many further quotations from Sir Sandford Fleming. "Imperial Defence"—that inspiring treatise of Sir Charles Dilke and Mr. Spenser Wilkinson—has also been turned to good account here, and the same applies to Sir John Colomb's "Defence of Great and Greater Britain," and Sir George Clarke's "Imperial Defences," though it should be mentioned that neither Sir Charles Dilke, Sir John Colomb, or Sir George Clarke, were in favour of the all-British Pacific cable scheme on the lines it finally took shape, partly for strategic and partly for financial reasons. This, the most important, part of the book, is more suggestive of a review article than anything else; in fact, most of what is of interest for the moment may be found in just such an article in the *Quarterly Review* of a little time back, as well as in a recent contribution by Mr. Charles Bright, F.R.S.E., to the *Nineteenth Century*—the main difference being that in the latter, the arguments in favour of the line are arranged with some sort of system and sequence. A book of this character should deal separately with the strategic aspect—which, indeed, is scarcely touched on (beyond quoting Lord Wolseley's well worn opinion), though forming one of the great characteristics of the scheme. Possibly, however, the editor (coming from Canada) is aware that the connecting links across British North America and in the Atlantic, are so open to attack from the United States Army, as well as from French warships at St. Pierre de Miquelon, that the system is of little real use on that score at present.

The principal feature of this chapter consists in arguing for State ownership of cables as a policy very largely based on Communism and Socialism in their best sense; and the editor reveals the fact that he is in favour of the State undertaking this sort of work, just as he is also in favour of municipal trading. We, however, should defend the project being undertaken as a subject of State partnership on an entirely different basis. As a principle, we strongly object to the State competing with private enterprise, or, indeed, entering upon undertakings such as are an ordinary useful subject of private enterprise. The "all-British" Pacific cable was considered to be for the good of the Empire as a whole, but none of the existing telegraph interests would undertake its realisation themselves, and they, moreover, strenuously opposed the scheme. This being so, it was evident that if it was to be realised at all, it must be realised by the State, seeing that no companies or individuals were prepared to undertake it, partly, they averred, because it would not pay. The best arguments for the line were on strategic grounds, which should naturally appeal to a Government from a national standpoint, though not to a body of business men unless considerably fortified by other arguments; and, it may be added, the very features which render the Pacific cable so excellent a strategic cable must always militate against it being a great commercial success. Yet it is just such lines as these that are needed by a nation to meet the contingency of war. It is, therefore, just such lines as these which a Government should recognise the necessity of taking up as a national affair, even though possibly at a loss for some time. The mere fact of the cable being there as a valuable strategic weapon should be considered to repay its cost. It may be added, it is in these cases only that a Government need have no

qualms about competing with private enterprise where necessity demands.

So far the line, as a commercial undertaking, has certainly not been crowned with any great degree of success. That, however, cannot be laid at the door of the contractors—the Telegraph Construction and Maintenance Co.—who, as usual, did their work admirably, and in most businesslike fashion. If, however, we note the course of events, some enlightenment may accrue as to the cause of the trouble.

In the first place, the entire contract was assigned to a single firm*—one that was, at the very time busily engaged in making and laying a competing line from the Cape to Australia for the allied "Eastern Companies," and not a mile of the Pacific Cable was laid until after the competing line had been working for upwards of a year. It is partly on this account, no doubt, that unkind suggestions have been made of playing into the hands of the very interests with whom competition was intended. Surely the contract should not, in any case, have been confined to a single firm, but split up amongst at least two; for, apart from the fact of the line being a national undertaking, by this means it would have been made and laid in less than half the time, and would, therefore, have been doing useful work, and earning something as soon as its rival line just laid, instead of being forestalled in many directions.

It would seem as though the powers that be—with a board of management entirely new to the work they were undertaking—had decided that precedent should go to the wind, and everything be done on entirely different lines to those adopted by the various existing cable companies of many years' standing. Thus the consulting engineers were empowered to carry out work more suggestive of that of an agent than of a consulting engineer, work which, for obvious reasons, the companies have always found it more satisfactory and economical to have performed by permanent officials on their own premises and solely in their employ, as servants of the company, and not as individuals with any other possible interests. It was only after things had advanced to a comparatively complete stage that a manager was appointed, selected from the retired ranks of Indian telegraph officials, with experience in the business of land wires rather than in that of a system of ocean cables. Similarly, the appointment of a secretary whose experience lay rather with steam laundries than with a cable system needs some justification. This is one of those interesting Treasury appointments in which the ties of relationship appear to outweigh anything else, for it is incredible that no other applications were made or considered; and it should not be forgotten that, as the Board had no experience whatever in connection with a cable system, the post of secretary thereto might be made almost anything by a capable man previously acquainted with his "job."

Far be it from us to suggest that blame can be fairly attached to any individual for the Pacific cable not having so far proved a greater success; but, in view of the facts, as the administrative arrangements adopted were in no way justified by precedent, questions are liable to be asked, and criticisms passed in such cases where public money is expended with insufficiently satisfactory results as regards working through organisation and traffic volume. When things look prosperous, no one challenges the methods adopted; not so, however, when the reverse happens.

But Mr. Johnson is in no way responsible for the subsequent career of the Pacific cable, and we can strongly recommend his little book to anyone wishing to quickly grasp, or refresh his memory about, the gradual—very gradual—progression of the scheme in the face of much interested opposition of a strong and vehement type. The author refers to the labours of Sir Sandford Fleming, Sir Charles Tupper, Mr. Henniker Heaton, Sir Edward Sassoon, and Mr. Charles Bright in this connection; but if a future edition should occur, he might note that the India-Rubber, Gutta-Percha, and Telegraph Works Co. is not—as he suggests—"briefly known as the Silver*ton* Co.," but, to be one letter less brief, as the Silver*town* Co. This error, or misprint, is made so constantly, notwithstanding the close association of Silvertown and Messrs. Robert and M. H. Gray with the active promotion of the project, that it is perhaps worth pointing out. In the event of another edition, an index should certainly also be supplied for a reference book such as this.

* This firm, by the way, declined to tender to the Canadian Government in 1894 on the score of not believing in the cable; but, in reality, because they are so closely allied to the "Eastern" Associated Companies. On the other hand, the Silvertown Co. and Messrs. Siemens Bros. had done their utmost to promote the scheme, and both their tenders to the Canadian Government were considerably lower than that subsequently sent in by the Telegraph Construction Co., though the latter (after the previous tenders had been published in Blue Books) was certainly the lowest in this instance.

## PHYSICAL SOCIETY.

At the meeting held June 10th, 1904, Dr. R. T. Glazebrook, F.R.S., President, in the chair, Prof. H. L. Callendar gave a demonstration of the "Projection of the Indicator Diagrams of a Petrol Motor." The motor itself was exhibited in action, with the indicator attached, and the actual diagrams were projected on the screen, showing the changes of form as they occur when the conditions of running are changed.

Prof. J. A Fleming read a paper entitled "A Model Illustrating the Propagation of an Alternating Current along a Telephone Cable, and a Simple Theory of the Same." The paper contains an account of a model constructed by the author, for the purpose of explaining in a simple manner the physical meaning of the mathematical expressions which are reached in discussing the propagation of alternating currents along a telephone or telegraph cable. The first part of the paper is concerned with a presentation of the elementary theory of the phenomena expressed in terms of complex quantities, and a solution is given for the potential and current distribution in the case of a semi-infinite cable, having a simple periodic E.M.F. applied at the end. This solution indicates that the potential, v, at any point in the cable has a maximum value which is less than that at the origin (E), in an assigned ratio, and shifted backwards by an assigned angle in phase. A geometrical interpretation was then given of the above equations, leading to a graphic representation of the distribution of potential in the cable at any moment, and the model shown illustrated the meaning of the above equation and the graphic interpretation of it. The paper then proceeds with a discussion of the theory, and a very simple proof is given of Mr. Heaviside's condition for the distortionless propagation of a wave of electric current. The criterion of distortion is applied in the case of one long submarine cable, and it is shown how far removed such a cable is from being a distortionless cable. The remedies which have been proposed are then discussed, and it is shown that it is hopeless to expect any real advantage merely by bringing the iron armour closer to the cable conductor, but that a large reward awaits any inventor who can bestow upon a long submarine cable inductance up to 300 or 400 henries per naut, without at the same time increasing much the usual capacity of 0·3 mfd. per naut. Allusion is made to Prof. Pupin's investigations concerning the insertion of inductance coils at intervals along the telephone lines, and the suggestion is made that there is no difficulty in applying this plan to subterranean telephone trunk lines, and that considerable improvement in the transmission of telephonic speech could thereby probably be effected.

Mr. T. H. Blakesley congratulated the author upon the interesting result contained in his paper, and discussed the mathematics of the subject.

The Chairman read a letter from Mr. Jacob, pointing out that the dielectric resistance of the 1880 Anglo-American cable, considered in the paper, is much higher, as it lies in the sea, than the figure quoted by the author, which was obtained at 75° F. and atmospheric pressure after 1 minute's electrification. The electrification or absorption of the dielectric, however, masked all the effects of the high insulation value. An inductance of 300 or 400 henries per naut was beyond possibility; the inductance should not be of a higher order than 1 henry per naut.

Dr. Fleming, in reply, said that the relation between the electrical constants of the cable which gave distortionless transmission was discovered and announced 20 years or more ago by Mr. Oliver Heaviside. All that he (Dr. Fleming) had attempted to do was to simplify and illustrate the proofs of this condition. The employment of complex quantities in the discussion of alternating current problems led to a considerable simplification of the analysis. As regards the practical realisation of Heaviside's distortionless condition for submarine cables, the figures given in the paper were merely intended to indicate the remoteness of its possibility. The correction furnished by Mr. Jacob for the insulation resistance of the dielectric when the cable was immersed did not affect the general conclusions, as if the insulation resistance were greater, the departure from the distortionless condition would be then still greater. He recognised that the "absorption" of the dielectric introduced a factor not taken into account in the mathematical theory. As regards the practical superior limit of inductance which might be given to a cable, no one could say what invention might not bring forth. He was glad to hear that an inductance of 1 henry per naut might improve matters sensibly, because he had devised a plan by which an approximation to this might be reached. Mr.

Jacob only confirmed the statement in his paper in expressing the opinion that an inductance of 300 to 400 henries per naut was impracticable.

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At the meeting held June 24th, 1904, Dr. R. T. Glazebrook, F.R.S., President, in the chair, a paper on "Chemical Dissociation and Electrical Conductivity," by A. E. GARRETT and Dr. R. S. WILLOWS, was read by Dr. Willows.

It has been shown by Beattie (*Phil. Mag.*, 1899) that a mixture of salt and iodine, when placed on a zinc plate and heated, gives rise to electrical conductivity, although separately no such effect is produced. This is shown to be due to the formation of zinc iodide. Following on this, the electrical conductivity produced by heating various salts is investigated under different conditions of temperature and electric field. A large excess of positive electricity is found in nearly every case.

A paper on "The Magnetisation of Iron in Bulk" was read by Dr. W. M. THORNTON. The paper is in three sections. The first describes a method of measuring large quantities of magnetism by the use of an exploring coil placed around the core and an exciting coil in series with a recording milli-voltmeter. This was applied to determine the complete loops of magnetisation for two rings of cast-steel and cast-iron weighing respectively 3 and 6 cwt. The results were checked by a quantometer. The second section deals with the curves of rise of magnetising currents, when the core is solid and when laminated, as affected by the reaction of the core currents, and also by the change of permeability during magnetisation. A second simple method is given of measuring large quantities of magnetism in circuits having a large time constant, suitable for testing dynamo-electric machines. From two curves of rise, with the current in one reversed, expressions are given for finding the total induction in the core and its ratio to the residual magnetism. In the last section an example is given of the sudden dip in the curve of rise, observed only with large cores. The growth of current in a coil surrounding a solid circular core is calculated by Heaviside's formula, assuming constant permeability. No dip is found in the calculated curve, and it is, therefore, caused by a brief magnetic impulse which corresponds to the slip of the molecules at saturation seen in Ewing's model of the magnetisation of iron. Photographs are given showing the direction of flow of eddy currents in cores of rectangular section of proportions 1 : 1, 1·5 : 1, and 2 : 1.

Prof. S. P. THOMPSON, referring to the curves showing the rise of the magnetising current, said he was not inclined to think that the effect was due to internal eddy currents in the core. The fact that the growth of the magnetisation current was irregular was well exhibited in separately excited dynamos with large field magnets, where the effect could be easily seen in the movements of the amperemeter needle.

Mr. W. H. PRETTY said that the curves shown by the author suggest the possibility of detecting cavities in steel castings, as such castings would doubtless give curves differing from those representing a truly solid block of the same material, cast at the same time, and subjected to the same after-treatment. It would be interesting to have a series of tests on the same block of steel, say, in which each process in the manufacture is represented, *i.e.*, as cast after annealing, and after the surface scale or skin has been removed to various depths; also after the block has been cut up into slabs or laminæ and put together again. Referring to the dip in the curves of rise of magnetisation observed with large cores, Mr. Pretty said it was not unlikely due to internal mechanical stress and the accompanying strain, and that as it became possible to obtain steel more and more homogeneous, such internal molecular changes would become more apparent.

Dr. THORNTON, in reply to Mr. Pretty, said that he was now experimenting upon the effect of cutting up a large core into laminæ and then building up the core again.

## NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

15,396. "Improved means for protecting the insulation of electric light flexible cords from dust, flies and such like vermin." J. YOUNG. July 11th.

15,419. "Improvements in laminated iron sections for alternating current transformers." J. H. BAINBRIDGE. July 11th.

15,441. "Automatic firing apparatus for guns and firearms having electrical or electro-mechanical ignition." H. VON PECHY and V. REA. July 11th. (Complete.)

15,452. "Improvements in systems of electrical distribution." J. S. PECK. July 11th. (Date applied for under Patents Act, 1901, August 8th, 1903, being date of application in United States.) (Complete.)

15,453. "Improvements in or relating to electric arc lamps." C. OLIVER. July 11th.

15,455. "Improvements in relays for automatic circuit breakers." M. B. FIELD, C. C. GARRARD and FERRANTI, LTD. July 11th.

15,467. "Improvements in vapour electric conductors." O. O. KRUH. July 11th. (Date applied for under Patents Act, 1901, July 11th, 1903, being date of application in United States.) (Complete.)

15,468. "Improvements in vapour electric lamps or rectifiers." E. WEINTRAUB. July 11th. (Date applied for under Patents Act, 1901, July 11th, 1903, being date of application in United States.) (Complete.)

15,469. "Improvements in and relating to vapour electric conductors." O. O. KRUH. July 11th. (Date applied for July 13th, 1903, being date of application in United States.) (Complete.)

15,472. "Improvements in electric incandescent lamps." A. FREY. July 11th. (Complete.)

15,495. "Improvements in dynamo-electric machines for regulating the charge and discharge of storage batteries used in combination with main generators." THE LANCASHIRE DYNAMO AND MOTOR CO., LTD., and R. S. MCLEOD. July 12th.

15,512. "An improved lid for accumulator and other acid-containing boxes or tanks." E. J. CLARK and HART ACCUMULATOR CO., LTD. July 12th. (Complete.)

15,517. "Dynamo-electric engine." J. LOMMATZSCH, B. MENSCH, and O. SIEGERT. July 12th. (Complete.)

15,525. "Improvements in and relating to electro-pneumatic actions for keyboard, and other musical instruments and the like." F. DREXLER. July 12th.

15,529. "A system of wire entanglements and electrically operated apparatus for the protection of the mouth of a harbour in war time." E. G. S. MCCLELLAN. July 12th.

15,551. "Improvements relating to the prevention of fires caused by short circuits, or by injury to electric conducting wires or cables." O. WILHELMI. July 12th.

15,561. "Improvements in indicators for electric oscillations." W. P. THOMPSON. (Gesellschaft fur drahtlose Telegraphie m.b.H., Germany.) July 12th. (Complete.)

15,568. "Improvements in electro-magnetic signalling devices for operating two or more alternate signals." J. WILLIS. July 12th.

15,567. "Improvements in electric or telephonic transmission." H. CARBONNELLE. July 12th. (Complete.)

15,581. "Improvements in telephone, telegraph, and other call systems." A. C. BROWN. July 13th.

15,599. "Metallic thermometrical electrical indicator." A. P. THOMPSON. July 13th.

15,612. "Improvements in means for changing or reversing the direction of electric currents." E. G. P. BOUSFIELD and THE OZONISED OXYGEN CO., LTD. July 13th.

15,614. "Improvements relating to dynamos used with other dynamos or cells." W. LANGDON-DAVIES and A. SOAMES. July 13th.

15,616. "Improvements in single-phase alternate current motors." CROMPTON AND CO., LTD., and R. GOLDSCHMIDT. July 13th.

15,617. "Improvements in electric contact or supporting gears." CROMPTON AND CO., LTD., and E. W. ABBOTT. July 13th.

15,618. "Improvements in and relating to electric circuit-breakers." CROMPTON & CO., LTD., and R. C. HARRIS. July 13th.

15,626. "Improvements in dynamo-electric machines." W. B. SAYERS and MAVOR & COULSON, LTD. July 13th.

15,627. "Improvements in electric clocks." G. B. BOWELL. July 13th.

15,632. "Improved system of protection for parallel electric feeders. THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) July 13th.

15,634. "Improvements in systems of electrical distribution." S. FERGUSON. (Date applied for under Patents Act, 1901, July 13th, 1903, being date of application in United States.) July 13th. (Complete.)

15,637. "Improvements in regulating mechanism for arc lamps." W. T. UPTON, J. E. ELLIOTT and H. B. PRATT. July 13th. (Complete.)

15,648. "Improvements in electric motor starters and electrical resistances." VERITYS LTD., and A. E. GOTT. July 14th.

15,651. "Improvements in life-guards for electrically-propelled vehicles or the like." E. A. GREAVES. July 14th.

15,691. "An improvement in electric lighting and advertising." A. E. MEAD. July 14th.

15,692. "An improvement in collecting electric currents from armatures or unipolar dynamo-electric machines." F. E. ELMORE. July 14th.

15,699. "Improvements in or relating to electrical resistances." W. BOEHM. July 14th. (Complete.)

15,701. "Improvements in instruments for determining the drop of potential in electric transmission systems." ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT. (Date applied for under Patents Act, 1901, July 14th, 1903, being date of application in Germany.) July 14th. (Complete.)

15,704. "Improvements in electricity meters." W. M. MORDEY and G. C. FRICKER. July 14th.

15,712. "Improvements in or connected with wireless signalling." L. H. WALTER. July 14th.

15,732. "Improvements in electric light fittings." VERITYS, LTD., and J. SOTHCOTT. July 15th. (Complete.)

15,762. "Improvements relating to the production of electrotypes or the like." S. COWPER-COLES & CO., LTD., and S. COWPER-COLES. July 15th.

15,770. "Improvements relating to boxes, covers, or containing cases for electric switches, fuses, and the like." T. H. MARSH and A. B. MUDIE. July 15th.

15,771. "An improved connector for the armature and commutator of dynamo-electric machines." SIEMENS BROS. & CO., LTD., and H. BERRY. July 15th.

15,772. "Improvements in the manufacture of insulated electric conductors and apparatus therefor." SIEMENS BROS. & CO., LTD., and W. DIESELHORST. July 15th. (Complete.)

15,778. "Improved contact stud and switch for use with surface contact systems of electric traction." W. GRIFFITHS and B. H. BEDELL. July 15th.

15,796. "Improvements in or relating to alternate current distributing systems." C. H. MERZ and B. PRICE. July 15th.

15,802. "Improvements in or relating to conduits for underground electrical wires or cables." M. J. STONE and E. T. FANWICK. July 15th.

15,869. "Improvements in installations for electrically operating railway points." SIEMENS BROS. & CO., LTD. (Siemens-Halske Actiengesellschaft, Germany.) July 16th. (Complete.)

15,872. "Improvements in arc lamps." G. VIARME. July 16th.

15,874. "Electrical fire extinguisher." H. RUPPERT. July 16th. (Complete.)

15,879. "Improvements in alternating electric current meters." ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT. (Date applied for under Patents Act, 1901, July 17th, 1903, being date of application in Germany.) July 16th. (Complete.)

## PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

### 1903.

COUPLINGS FOR ELECTRIC AND OTHER WIRES. A. J. Boult. (W. Hofmann, Germany.) 1,077. January 15th.

WIRELESS TELEGRAPHY. P. M. Justice. (W. S. Hogg, United States.) 1,855. January 26th.

ELECTRIC LAMPS OF THE CHARACTER KNOWN AS "VAPOUR LAMPS." C. O. Bastian and A. E. Salisbury. 1,995. January 27th.

ELECTRO-CAPILLARY RELAYS AND THE LIKE. J. T. Armstrong and A. Orling. 2,053. January 28th.

ELECTRO-CAPILLARY RELAYS AND THE LIKE. J. T. Armstrong and A. Orling. 2,053A. January 28th.